



Aerospace Medicine
and Biology
A Continuing
Bibliography
with Indexes

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AEROSPACE MEDICINE AND BIOLOGY

**A CONTINUING BIBLIOGRAPHY
WITH INDEXES**

(Supplement 304)

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in November 1987 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*.



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INTRODUCTION

This Supplement to *Aerospace Medicine and Biology* lists 161 reports, articles and other documents announced during November 1987 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. The first issue of the bibliography was published in July 1964.

In its subject coverage, *Aerospace Medicine and Biology* concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the Earth's atmosphere or in interplanetary space. References describing similar effects of biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. In general, emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion.

Each entry in the bibliography consists of a bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged by *STAR* categories 51 through 55, the Life Sciences division. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. The *IAA* items will precede the *STAR* items within each category.

Seven indexes — subject, personal author, corporate source, foreign technology, contract, report number, and accession number — are included.

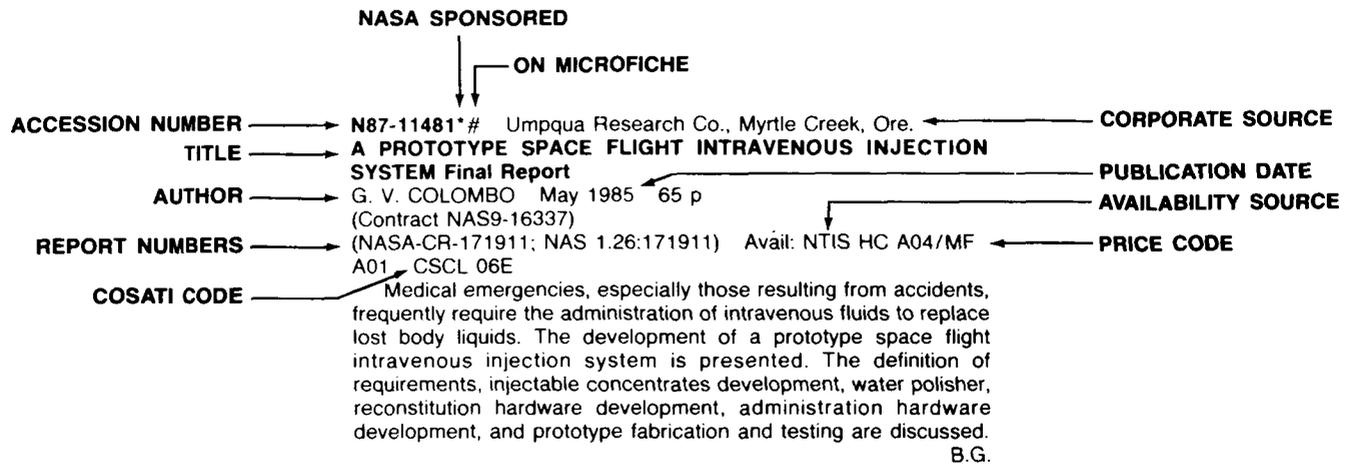
An annual index will be prepared at the end of the calendar year covering all documents listed in the 1987 Supplements.

Information on the availability of cited publications including addresses of organizations and NTIS price schedules is located at the back of this bibliography.

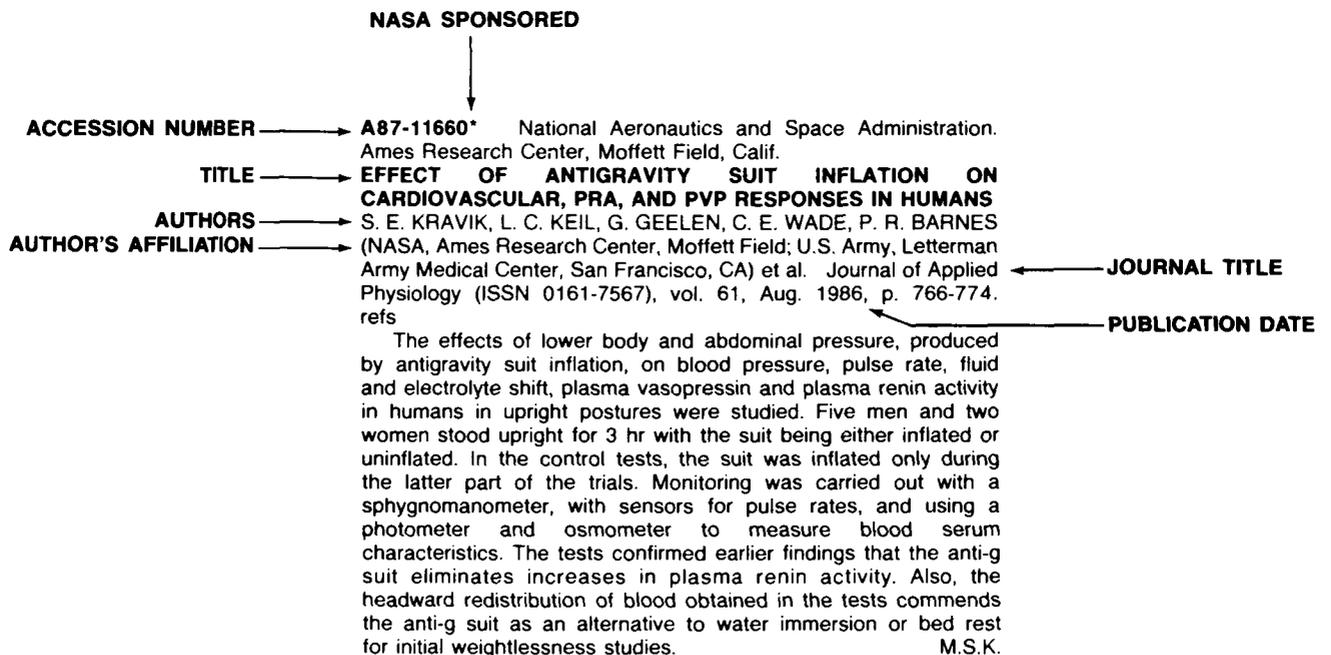
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TYPICAL REPORT CITATION AND ABSTRACT



TYPICAL JOURNAL ARTICLE CITATION AND ABSTRACT



AEROSPACE MEDICINE AND BIOLOGY

A Continuing Bibliography (Suppl. 304)

DECEMBER 1987

51

LIFE SCIENCES (GENERAL)

Includes genetics.

A87-48301* Michigan Univ., Ann Arbor.

THE SUPRASTRUCTURE OF THE SACCULAR MACULA

MURIEL D. ROSS, THOMAS E. KOMOROWSKI, KATHLEEN M. DONOVAN, and KENNETH G. POTE (Michigan, University, Ann Arbor) *Acta Oto-Laryngologica* (ISSN 0001-6489), vol. 103, 1987, p. 56-63. refs

(Contract NAS2-10535; NAG2-325)

The ultrastructure of the rat's macular end organ was examined. Primary fixatives containing 4 or 8 percent tannic acid (with 1 hr fixation time) were found to be optimal for preserving the macular suprastructure from the macular surface to the otoconia. In agreement with observations of other workers, the suprastructure of the macular end organ showed two kinds of filamentous material of different organization: the material which supports the otoconia, the 'otoconial membrane', and the filamentous material, the 'supramacular substance'. However, in contrast to earlier reports, the fluid-filled channels around the stereociliary tufts and a slitlike space immediately above the macula were found to be artefacts of tissue preparation. The results were confirmed in decalcified samples. I.S.

A87-48303* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

ELECTROPHORETIC ENZYME ANALYSIS OF NORTH AMERICAN AND EASTERN ASIAN POPULATIONS OF AGASTACHE SECT. AGASTACHE (LABIATAE)

JAMES E. VOGELMANN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena) and GERALD J. GASTONY (Indiana University, Bloomington) *American Journal of Botany* (ISSN 0002-9122), vol. 74, March 1987, p. 385-393. refs (Contract NSF BSR-82-06056)

Genetic relationships among the seven species of *Agastache* sect. *Agastache* common in North America and the one found in eastern Asia were assessed using starch-gel electrophoresis of twelve enzymatic proteins. Nei's (1976) genetic distance and identity values, calculated among the 32 populations used in this study, partitioned the *Agastache* section into four discrete groups: (1) *A. nepetoides* (eastern North America), (2) *A. scrophulariifolia* and *A. foeniculum* (eastern and central North America), (3) the four species of the western U.S. (*A. urticifolia*, *A. occidentalis*, *A. parvifolia*, and *A. cusickii*), and (4) *A. rugosa* (eastern Asia). The Asian *Agastache*, separated from its American congeners for over 12 million years, differed from American populations at only two (the IDH-1 and LAP-1 alleles) of the fifteen loci surveyed; these alleles were not found in any of the North American plants. Nei's genetic distances between the Asian and North American populations ranged from 0.2877 to 0.6734. I.S.

A87-48304* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

CHANGES IN PITUITARY GROWTH HORMONE CELLS PREPARED FROM RATS FLOWN ON SPACELAB 3

R. GRINDELAND, W. C. HYMER, M. FARRINGTON, T. FAST, C. HAYES, K. MOTTER, L. PATIL, and M. VASQUES (NASA, Ames Research Center, Moffett Field, CA; Pennsylvania State University, University Park; Sant American Journal of Physiology: Regulatory, Integrative and Comparative Physiology (ISSN 0363-6119), vol. 21, 1987, p. R209-R215. refs

The effect of exposure to microgravity on pituitary gland was investigated by examining cells isolated from anterior pituitaries of rats flown on the 7-day Spacelab 3 mission and, subsequently, cultured for 6 days. Compared with ground controls, flight cells contained more intracellular growth hormone (GH); however, the flight cells released less GH over the 6-day culture period and after implantation into hypophysectomized rats than did the control cells. Compared with control rats, glands from large rats (400 g) contained more somatotrophs (44 percent compared with 37 percent in control rats); small rats (200 g) showed no difference. No major differences were found in the somatotroph ultrastructure (by TEM) or in the pattern of the immunoreactive GH variants. However, high-performance liquid chromatography fractionation of culture media indicated that flight cells released much less of a biologically active high-molecular weight GH variant, suggesting that space flight may lead to secretory dysfunction. I.S.

A87-48305* Howard Univ., Washington, D. C.

ESTIMATION OF LEFT VENTRICULAR MASS IN CONSCIOUS DOGS

BERNELL COLEMAN, LAVAL N. COTHRAN, E. L. ISON-FRANKLIN (Howard University, Washington, DC), and E. W. HAWTHORNE *American Journal of Physiology: Heart and Circulatory Physiology* (ISSN 0363-6135), vol. 20, 1986, p. H1149-H1157. refs (Contract NAG2-250)

A method for the assessment of the development or the regression of left ventricular hypertrophy (LVH) in a conscious instrumented animal is described. First, the single-slice short-axis area-length method for estimating the left-ventricular mass (LVM) and volume (LVV) was validated in 24 formaldehyde-fixed canine hearts, and a regression equation was developed that could be used in the intact animal to correct the sonomicrometrically estimated LVM. The LVM-assessment method, which uses the combined techniques of echocardiography and sonomicrometry (in conjunction with the regression equation), was shown to provide reliable and reproducible day-to-day estimates of LVM and LVV, and to be sensitive enough to detect serial changes during the development of LVH. I.S.

A87-48479* Salk Institute for Biological Studies, San Diego, Calif.

THE TRIOSE MODEL - GLYCERALDEHYDE AS A SOURCE OF ENERGY AND MONOMERS FOR PREBIOTIC CONDENSATION REACTIONS

ARTHUR L. WEBER (Salk Institute for Biological Studies, San Diego, CA) *Origins of Life* (ISSN 0302-1688), vol. 17, no. 2, 1987, p. 107-119. refs
(Contract NSG-7627)

Glyceraldehyde acts as a source of energy and monomers in a new model of the origin of life. The simplest form of the model functions by converting formaldehyde from the environment into glyceraldehyde which spontaneously forms hemiacetal adducts that are oxidized to polyglyceric acid. Polyglyceric acid, in turn, acts as an autocatalyst with a rudimentary replicating ability. A unique property of the model is its ability to unite the origin of metabolism and the origin of polymer synthesis into a single process. Furthermore, the chemical resemblance of the model to glycolysis gives it the potential to develop a biological metabolism in a straightforward manner. Author

A87-48480* San Francisco State Univ., Calif.

SOLUBLE MINERALS IN CHEMICAL EVOLUTION. II - CHARACTERIZATION OF THE ADSORPTION OF 5-PRIME-AMP AND 5-PRIME-CMP ON A VARIETY OF SOLUBLE MINERAL SALTS

STEPHEN CHAN, JAMES ORENBERG (San Francisco State University, CA), and NOAM LAHAV (Jerusalem, Hebrew University, Rehovot, Israel) *Origins of Life* (ISSN 0302-1688), vol. 17, no. 2, 1987, p. 121-134. refs
(Contract NAGW-324)

The adsorption of 5-prime-AMP and 5-prime-CMP is studied in the saturated solutions of several mineral salts as a function of pH, ionic strength, and surface area of the solid salt. It is suggested that the adsorption which results from the binding between the nucleotide molecule and the salt surface is due to electrostatic forces. The adsorption is reversible in nature and decreases with increasing ionic strength. K.K.

A87-48481* Hebrew Univ. of Jerusalem, Rehovot (Israel).

THE BIOGEOCHEMICAL CYCLE OF THE ADSORBED TEMPLATE. I - FORMATION OF THE TEMPLATE

DANIEL LAZARD, NOAM LAHAV (Jerusalem, Hebrew University, Rehovot, Israel), and J. B. ORENBERG (San Francisco State University, CA) *Origins of Life* (ISSN 0302-1688), vol. 17, no. 2, 1987, p. 135-148. refs
(Contract NAGW-324)

Experimental results are presented for the verification of the first adsorption step of the 'adsorbed template' biogeochemical cycle, a simple model for a primitive prebiotic replication system. The adsorption of Poly-C, Poly-U, Poly-A, Poly-G, and 5'-AMP, 5'-GMP, 5'-CMP and 5'-UMP onto gypsum was studied. It was found that under the conditions of the experiment, the polymers have a very high affinity for the mineral surface, while the monomers adsorb much less efficiently. Author

A87-48482

CHEMICAL EVOLUTION OF THE CITRIC ACID CYCLE - SUNLIGHT PHOTOLYSIS OF ALPHA-KETOGLUTARIC ACID

THOMAS G. WADDELL, BARRY S. HENDERSON, RANDALL T. MORRIS, CHARLES M. LEWIS, and ANTHONY G. ZIMMERMANN (Tennessee, University, Chattanooga) *Origins of Life* (ISSN 0302-1688), vol. 17, no. 2, 1987, p. 149-153. refs

Attempts made to induce (1) an aldol addition of acetic to oxalacetic acid to produce citric acid, (2) the addition of water to fumaric acid to yield malic acid, and (3) the oxidative decarboxylation of alpha-ketoglutaric acid to give succinic acid are discussed. It is found that sunlight photolysis of alpha-ketoglutaric acid does produce succinic acid; this is a nonenzymatic reaction which mimics a step in the modern citric acid cycle. It is suggested that this chemical reaction occurred on the primitive earth and was involved in the origin and evolution of the Krebs cycle pathway. K.K.

A87-48483

HOW MANY GENES TO START WITH? A COMPUTER SIMULATION ABOUT THE ORIGIN OF LIFE

URSULA NIESERT (Freiburg, Universitaet, Freiburg im Breisgau, West Germany) *Origins of Life* (ISSN 0302-1688), vol. 17, no. 2, 1987, p. 155-169. refs

The 'package model' which envisages independently-replicating primordial compartments containing ensembles of primordial genes is reviewed. A computer simulation allowing for the complementarity of RNA as well as the abortive termination of replication yielded results suggesting that life could not have started with more than three genes. If this were not the case, the primordial replicase would have to achieve a 13-fold reduction of the replicational error rate and a 10-25-fold reduction of undue chain termination. K.K.

A87-48992

LIFE SCIENCES AND SPACE RESEARCH XXII(1); PROCEEDINGS OF THE TOPICAL MEETING AND WORKSHOP VII OF THE 26TH COSPAR PLENARY MEETING, TOULOUSE, FRANCE, JUNE 30-JULY 11, 1986

F. R. EIRICH, ED. (New York, Polytechnic University, Brooklyn), H. BUECKER, ED., G. HORNECK, ED. (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany), A. B. COX, ED. (Colorado State University, Fort Collins), and R. J. M. FRY, ED. (Oak Ridge National Laboratory, TN) Topical Meeting sponsored by COSPAR; Workshop sponsored by COSPAR and National Council on Radiation Protection and Measurements. *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, 353 p. For individual items see A87-48993 to A87-49033.

The topics discussed include the minimal requirements for the emergence of life, the effects of heavy ion mechanisms on biological matter, the effects of heavy ions on biological systems with special emphasis on the central nervous system, and the reassessment of the guidelines of radiation protection in space. Papers are presented on the minimum requirements for the evolution of a cell, the minimum requirements for single cell activity, the physical events of heavy ion interactions with matter, and the mechanisms of radiation-induced strand break formation in DNA and polynucleotides. Consideration is given to track structure in biological models, the effects of heavy ions on cycling stem cells, the occurrence of brain tumors in rhesus monkeys exposed to 55-MeV protons, and the long-term effects of low doses of Fe-56 ions on the brain and retina of the mouse. Additional papers are on the effect of space radiation on the nervous system, animal studies of life shortening and cancer risk from space radiation, and radiation protection standards in space. I.S.

A87-48993

THE MINIMUM REQUIREMENTS FOR THE EVOLUTION OF A CELL

PUSHPA M. BHARGAVA (Centre for Cellular and Molecular Biology, Hyderabad, India) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 7-11.

The transition from the chemical to the biological evolution, that is, the formation of the first living cell, is discussed together with the basic criteria for the first cell. Consideration is given to the four types of organization within a living cell: (1) intramolecular organization of atoms into macromolecules possessing tertiary structure, (2) organization of molecular species into structures which do not have any phase separation (e.g., ribosomes), (3) organization of molecular species into structures in which there is a clear phase separation (e.g., mitochondria), and (4) the formation of channels in the cytoplasm through which certain molecular species may move much faster than their diffusion coefficients will allow. The feasible processes which led to these kinds of structures to arise from the end-products of chemical evolution are examined. I.S.

A87-49001**MINIMUM REQUIREMENTS FOR SINGLE CELL ACTIVITY**

IWAO TABUSHI (Kyoto University, Japan) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 45-52. refs

The minimum requirements for 'momentary cell activity' (such as electron or pH flux) are examined. To study electron and proton fluxes, artificial liposomes modified with cytochrome-c3 were prepared and used with an exterior electron donor, and an interior electron sink. Rapid transport rates were observed when aqueous Na₂S₂O₄ was mixed with these liposomes, with the observed kinetics being second-order with respect to cyt-c3. Conditions necessary for chemical mimicking the energy conversion system in the SO₄(2-) reducing bacteria and for preparing artificial single cells of mitochondria type are discussed. I.S.

A87-49002**AUTOPOIESIS AND THE ORIGIN OF BACTERIA**

G. R. FLEISCHAKER and L. MARGULIS (Boston University, MA) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 53-55. refs

An autopoietic system is defined as a system which exhibits the characteristics of identity, circularity, and integrity. The property of the 'identity' requires that the system is enclosed within a boundary. Autopoietic 'circularity' means that the constituent parts and the enclosing boundary arise as a consequence of the internal activities; thus, they are self-producing. The 'integrity' refers to the recursive organization of the autopoietic system: there is a continual replacement and refinement of components drawn from its surroundings. The concept of autopoiesis as 'the origin of life' concept includes more than the origin of the cell components; it implies a system in which metabolism engenders the closure and organization. Bacteria, as the simplest modern biological autopoietic systems, are suggested for use as the starting point in studies of minimal systems capable of sustaining life. I.S.

A87-49004**PHYSICAL EVENTS OF HEAVY ION INTERACTIONS WITH MATTER**

H. G. PARETZKE (Gesellschaft fuer Strahlen- und Umweltraumforschung mbH, Neuherberg, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 67-73. refs

The types of interactions of heavy charged particles with matter include elastic atomic/nuclear collision (leading to an appearance of recoiled target ions), inelastic nuclear collision (causing generation of new heavy ions), and inelastic atomic collision, (leading to the excitation and ionization of the projectile and/or the target material). These reactions can be detected by the tracks left in the matter, which are specific for a given disturbance. The use of the track structures for computer simulations of the sequence of the primary physical events produced by heavy ion interactions is discussed together with problems arising when the targets are in the condensed state (e.g., living cells) or if the projectile ions carry their own loosely bound electrons. I.S.

A87-49007**MECHANISM OF RADIATION-INDUCED STRAND BREAK FORMATION IN DNA AND POLYNUCLEOTIDES**

D. SCHULTE-FROHLINDE (Max-Planck-Institut fuer Strahlenchemie, Muelheim an der Ruhr, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 89-96. refs.

The chemical steps which lead to strand breaks (SBs) in polynucleotides and in single- and double-stranded DNA by OH radicals (formed following the exposure of aqueous solutions to gamma-irradiation) or by laser excitation are discussed. For a double-stranded break in DNA by a single OH radical, an interstrand radical transfer is postulated as the mechanism's key step. SB formation by photoionization using laser excitation mimics the direct effect of high-energy irradiation. In this case, the direct absorption of the radiation energy by the DNA is followed by the ejection of an electron from a base, the sugar, or the phosphate group. Whereas the OH-radical-induced mode of SB formation is predominantly a slow process, taking milliseconds to seconds for the completion, the predominant process in the laser-induced SB formation is much faster (100 microsec or less). I.S.

A87-49008**THEORETICAL CONSIDERATION OF THE CHEMICAL PATHWAYS FOR RADIATION-INDUCED STRAND BREAKS**

A. CHATTERJEE, P. KOEHL, and J. L. MAGEE (California, University, Berkeley) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 97-105. refs

(Contract DE-AC03-76SF-00098)

A theoretical approach to the understanding of the biochemical mechanisms of indirect action of ionizing radiation on SV40-DNA in aqueous solution is presented. The extent of OH attack on the sugar moiety and bases has been calculated. A realistic model for the DNA (in B form) based on available X-ray diffraction data is used, and specific reaction sites for the OH radicals are obtained. A Monte Carlo scheme is used to follow the diffusion and reaction of the OH radicals. Effects of track structure have been considered, and the single strand break values for 14 MeV electrons (low-LET) and 670 MeV/u and 40 MeV/u neon particles are presented. Calculated results are in agreement with available experimental data. It has been found that, regardless of the qualities of radiation, 80 percent of the OH attack on DNA is on the bases and 20 percent is on the deoxyribose. From probability considerations only, it appears that the number of double-strand breaks varies linearly with dose. Author

A87-49009**GENETIC RESPONSE OF BACTERIAL SPORES TO VERY HEAVY IONS**

K. BALTSCHUKAT (Ulm, Universitaet, West Germany), G. HORNECK, H. BUECKER, R. FACIUS, and M. SCHAEFER (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 109-115. refs

Using spores of two *Bacillus subtilis* strains differing in repair capacity, repair and mutation induction were studied in the spores after irradiation with very heavy ions (up to uranium) with specific particle energies up to 18.6 MeV/u. The results indicate that repair and mutation induction after heavy ion irradiation are closely related to each other and that both phenomena strongly depend on the atomic number and specific energy of the ions. The effects are discussed in comparison with results obtained after X-irradiation. Author

A87-49010

MICRODOSIMETRIC CONSIDERATIONS OF EFFECTS OF HEAVY IONS ON MICROORGANISMS

T. TAKAHASHI, F. YATAGAI, S. KONNO, T. KATAYAMA, and I. KANEKO (Institute of Physical and Chemical Research, Wako, Japan) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 117-125. Research supported by NRI Life Science Japan. refs

The energy dose around the trajectory of an ion was calculated using Tabata and Ito's (1974 and 1981) energy deposition algorithm for fast electrons, which takes into account the transmission coefficient. This algorithm is an improved version of Kobetich and Katz's (1969) energy dissipation algorithm, and gives a better fit to data in a wider region of electron energy. The result of the calculation was successfully applied to the interpretation of inactivation cross sections of *B. subtilis* spores and vegetative cells of *E. coli* by C, He, and N ions. I.S.

A87-49011

HEAVY-ION EFFECTS ON CELLULAR AND SUBCELLULAR SYSTEMS - INACTIVATION, CHROMOSOME ABERRATIONS AND STRAND BREAKS INDUCED BY IRON AND NICKEL IONS

G. KRAFT, W. KRAFT-WEYRATHER (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, West Germany), E. A. BLAKELY, and R. ROOTS (California, University, Berkeley) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 127-136. BMFT-supported research. refs
(Contract DE-AC03-76SF-00098; NIH-CA-15184)

The effects of the parameters of track formation (e.g., the LET value and the particle energy) of the Fe and Ni particles on cell damage, such as the cell death rate, the number of chromosomal aberrations, and the induction of single- and double-strand breaks in DNA were investigated using cell cultures and isolated SV40 DNA. The plots of cross sections of the cell inactivation, the induction of chromosomal aberration, and the double strand breaks in the viral DNA versus LET all revealed back-bending of the curves at higher LET values. These hooks were observed even though the sensitivity of the targets differed by two orders of magnitude, suggesting that the biological efficiency of LET is determined by two different processes: first, the biological efficiency increases with LET because of the production of more double-strand breaks; secondly, there is a decrease of efficiency because of recombination processes. I.S.

A87-49012* California Univ., Berkeley.

DOSE PROTRACTION STUDIES WITH LOW- AND HIGH-LET RADIATIONS ON NEOPLASTIC CELL TRANSFORMATION IN VITRO

TRACY CHUI-HSU YANG, LAURIE M. CRAISE, CORNELIUS A. TOBIAS (California, University, Berkeley), and MAN-TONG MEI (South China Agricultural University, Guangzhou, People's Republic of China) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 137-147. refs
(Contract NASA ORDER T-7163-B; DE-AC03-76SF-00098; NIH-CA-15184)

The effects of the low- and high-LET radiation (by X-rays, Co-60, and heavy ions) on the transformation of neoplastic cells were studied using cultured C3H10T1/2 mouse embryo cells. The transformed colonies in the confluent cell monolayers were recognized as focuses composed of highly polar fibroblastic multilayered criss-cross arrays of densely stained cells. For the

low-LET radiation, there was a decrease in cell killing and cell transformation frequency when cells were irradiated with fractionated doses and at a low dose rate, indicating that cultured mammalian cells can repair both subtransformation and potential transformation lesions. No sparing effect, however, was found for the high-LET radiation. An enhancement of cell transformation was observed for low-dose/rate argon (400 MeV/u; 120 keV/micron) and iron particles (600 MeV/u; 200 keV/micron). The molecular mechanism for this enhancement effect is not known. I.S.

A87-49013

BIOLOGICAL EFFECTS OF HEAVY IONS IN ARABIDOPSIS SEEDS

U. BORK, K. GARTENBACH, C. KOCH, and A. R. KRANZ (Frankfurt, Universitaet, Frankfurt am Main, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 149-152. refs

Irradiation of dry seeds of *Arabidopsis* with heavy ions (HZE-particles) produced by UNILAC-accelerator yielded aberrations in survival rate and embryo vitality. The damage increased with particle density and charge. Cross sections in the range of 0.2-1.0 sq microns for Ne and Ar and 2.0-10.0 sq microns for Xe were estimated. Soaked seeds were more sensitive than dry seeds (cross-section 2.0-10.0 sq microns for Ar). The induced total damage in the irradiated seeds was estimated adding the different damages weighted by certain factors. These results will be used as base data for the interpretation and evaluation of spaceflight experiments on the biological effects of cosmic radiation. Author

A87-49014* California Univ., Berkeley.

EARLY AND LATE MAMMALIAN RESPONSES TO HEAVY CHARGED PARTICLES

E. J. AINSWORTH (California, University, Berkeley) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 153-165. refs
(Contract NASA ORDER T-71630B; DE-AC03-76SF-00098; NIH-CA-15184)

This overview summarizes murine results on acute lethality responses, inactivation of marrow CFU-S and intestinal microcolonies, testes weight loss, life span shortening, and posterior lens opacification in mice irradiated with heavy charged particles. RBE-LET relationships for these mammalian responses are compared with results from in vitro studies. The trend is that the maximum RBE for in vivo responses tends to be lower and occurs at a lower LET than for inactivation of V79 and T-1 cells in culture. Based on inactivation cross sections, the response of CFU-S in vivo conforms to expectations from earlier studies with prokaryotic systems and mammalian cells in culture. Effects of heavy ions are compared with fission spectrum neutrons, and the results are consistent with the interpretation that RBEs are lower than for fission neutrons at about the same LET, probably due to differences in track structure. Author

A87-49015

QUANTITATIVE INTERPRETATION OF HEAVY ION EFFECTS - COMPARISON OF DIFFERENT SYSTEMS AND ENDPOINTS

J. KIEFER (Giessen, Universitaet, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 169-178. Research supported by the Gesellschaft fuer Schwerionenforschung mbH and BMFT. refs

The survival and mutation induction behaviors of yeast and mammalian cells exposed to heavy ion radiation were analyzed. It was found that the differences are not due to the different sizes of the sensitive sites nor to the different inherent sensitivities; both were taken into account in the mathematical formalism. In survival, the major discrepancy lies in the shoulder region. If the final slopes are adjusted with respect to the varying production of primary lesions, the survival curves of the yeast can be correctly predicted. This is not the case for mammalian cells, where a rapid loss of the shoulder with LET was observed. This behavior is interpreted to indicate that the reparability of heavy ion lesions is different in the two systems. With respect to mutation induction, the process is theoretically expected to decrease with higher LET. This is found in yeast but not in mammalian cells, where the mutation induction actually increases with LET. I.S.

A87-49016

TRACK STRUCTURE IN BIOLOGICAL MODELS

S. B. CURTIS (California, University, Berkeley) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 179-185. refs

The three-dimensional patterns created by high-energy heavy ions as they lose energy are referred to as their track structures. The methods used in several models of biological action to treat the track structure are reviewed. The models include the ion-gamma kill model of Katz et al. (1971), the theory of dual radiation action of Kellerer and Rossi (1972 and 1978), and the lethal and potentially lethal unified repair model of Curtis (1986). The different concepts used to describe track structure in each model are introduced, and their applicability is discussed. I.S.

A87-49017

THE EVOLVING MICROLESION CONCEPT

PAUL TODD (Bioprocessing and Pharmaceutical Research Center, Philadelphia, PA) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 187-189. refs

The concept of 'microlesions', introduced by Grahn (1973) and defined as linear arrays of killed and damaged cells, is explored by assessing data on the in vitro and in vivo carcinogenesis (in C3H10T1/2 mouse cells and in Harder's glands of mice respectively) induced by iron-ion irradiation. These data sets were interpreted on the basis of track calculations, assumed to represent microlesions. It was found that the action cross section for tumor induction in cultured cells is about 0.032 sq micron, while in the mouse harderian gland, the action cross section is only 1/1000th as great. This difference in the carcinogenic sensitivity is a reflection of biological difference between these two systems, neither of which may be quantitatively applicable to the effects of heavy ions on humans in space. I.S.

A87-49018

BIOLOGICAL EFFECTS OF HEAVY IONS FROM THE STANDPOINT OF TARGET THEORY

ROBERT KATZ (Nebraska, University, Lincoln) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 191-198. DOE-sponsored research. refs

Target theory is used to model the response of a large number of different detectors and biological systems to heavy ions. A procedure is described for determining the action cross section, making possible comparison with measurements which arise from beams of particles in homogeneous track segment irradiation. With biological cells, the low-LET response is dominated by the gamma-kill mode. For biological detectors, four radiosensitivity parameters are required by the present theory which are extracted from survival curves at several high-LET bombardments passing through the grain count regime, and at high doses. Once these parameters are known, the systematic response of biological detectors to all high-LET bombardments can be determined, separating ion kill from gamma kill, predicting the response to a mixed radiation environment, and predicting low-dose response. R.R.

A87-49019

EFFECTS OF HEAVY IONS ON CYCLING STEM CELLS

MICHAEL P. HAGAN, E. VINCENT HOLAHAN (DNA, Armed Forces Radiobiology Research Institute, Bethesda, MD), and E. JOHN AINSWORTH (California, University, Berkeley) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 201-211. refs

Murine marrow stem cells assayed with the spleen colony assay have been shown to be largely in a noncycling state. In the unirradiated animal, where these spleen-colony-forming units transit normally between a nonproliferative state and active proliferation, exposure to a sufficient dose of ionizing radiation increases the frequency (probability) of this transition. For low-LET irradiation, marrow stem cells are not induced into cycle until a threshold dose is achieved. This dose appears to be in the range 50 to 100 cGy, inducing proliferation in an all-or-nothing manner. For irradiation with heavy charged particles, however, the threshold dose is dependent on mass and energy. Irradiation with particles of sufficient mass and energy stimulates active proliferation even at the smallest doses tested, 5 cGy. Further, this response does not appear to result from an all-or-nothing effect. Rather, individual animals with intermediate levels of stem-cell cycling have been observed. These data support the notion that locally controlled hemopoiesis can be affected by local deposition of radiation damage. Author

A87-49020

OCCURRENCE OF BRAIN TUMORS IN RHESUS MONKEYS EXPOSED TO 55-MEV PROTONS

D. H. WOOD, M. G. YOCHMOWITZ, K. A. HARDY, and Y. L. SALMON (USAF, School of Aerospace Medicine, Brooks AFB, TX) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 213-216. refs

Twenty-year observation of monkeys exposed to single doses of high energy protons simulating solar particles revealed that the most prevalent fatal cancers were brain tumors in the group of animals exposed to 55-MeV protons. Of 72 animals (50 males and 22 females) receiving 0.25 to 8.0 Gy total body surface dose, nine developed fatal tumors classified as grade IV astrocytoma or glioblastoma multiforme. The latent period for tumor development ranged from 14 months to 20 years, with a median of 5 years.

Doses associated with the tumors were 4.0 to 8.0 Gy. Eight males and one female were affected. Depth-dose determinations suggest that the high incidence of cerebral neoplasia is associated with the Bragg Peak energy distribution of the 55-MeV protons. Comparison of the tumor incidence with that in humans with brain exposures incidental to radiotherapy indicates a high biological effectiveness compared with gamma radiation. Studies are in progress to attempt to replicate the results in rodents and establish a dose-response curve for proton-induced brain tumors. Author

A87-49021**USE OF PRIMARY CELL CULTURES TO MEASURE THE LATE EFFECTS IN THE SKINS OF RHESUS MONKEYS IRRADIATED WITH PROTONS**

A. B. COX, J. T. LETT (Colorado State University, Fort Collins), and D. H. WOOD (USAF, School of Aerospace Medicine, Brooks AFB, TX) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 217-222. refs

(Contract F33615-85-C-4514)

Previous pilot investigations of the uses of primary cell cultures to study late damage in stem cells of the skin of the New Zealand white rabbit and the rhesus monkey have been extended to individual monkeys exposed to 55-MeV protons. Protons of this energy have a larger range in tissue of (about 2.6 cm) than the 32-MeV protons (about 0.9 cm) to which the animals in earlier studies had been exposed. Although the primary emphases in the current studies were improvement and simplification in the techniques and logistics of transportation of biopsies to a central analytical facility, comparison of the quantitative measurements obtained thus far for survival of stem cells in the skins from animals irradiated 21 years ago reveals that the effects of both proton energies are similar. Author

A87-49023* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LONG TERM EFFECTS OF LOW DOSES OF FE-56 IONS ON THE BRAIN AND RETINA OF THE MOUSE - ULTRASTRUCTURAL AND BEHAVIORAL STUDIES

DELBERT E. PHILPOTT (NASA, Ames Research Center, Moffett Field, CA) and JAIME MIQUEL (Linus Pauling Institute of Science and Medicine, Palo Alto, CA) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 233-242. refs

Eight-month-old male C57BL6 mice were exposed without anesthesia to whole-body irradiation in circular holders. The mice were tested for behavioral decrements after 0.5 and 50 rads of Fe particle irradiation at 6 and 12 months postirradiation to obtain long-term results. A standard maze was used, and the animals were timed for completion thereof. A string test also was administered to the mice, testing their ability to grasp and move along a string to safety. The results from animals exposed to 50 rads were significantly different from control results to $p =$ less than 0.001 in both systems of testing. The hippocampus (believed to be the location of environmental interaction in the brain) and the retina were examined for ultrastructural changes. The ultrastructural changes were similar to those found in the Cosmos 782, 936, and Argon experiments. The mouse data indicate that iron particles were able to induce long-term changes in the central nervous system which led to behavioral impairment. Author

A87-49024**THE EFFECT OF SPACE RADIATION ON THE NERVOUS SYSTEM**

GRANT E. GAUGER (California, University, San Francisco and Berkeley), CORNELIUS A. TOBIAS, TRACY YANG, and MONROE WHITNEY (California, University, Berkeley) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 243-249. refs

(Contract DE-AC03-76SF-00098)

The information available on the effects of cosmic radiation on the living organisms and cultured cells is examined, with special attention given to the effects on nervous system. Evidence is presented that the glial system and the blood-brain barrier are relatively sensitive to injury by ionizing radiation. Cellular studies indicate that heavy ions can produce serious membrane lesions and multiple chromatin breaks; it is suggested that some of the signs of premature aging observed in irradiated animals may represent a delayed effect of chromatin misrepair in brain. Late signs of such injuries are altered microcirculation, decreased local metabolism, reduction in synaptic density, premature loss of neurons, myelin degeneration, and glial proliferation. I.S.

A87-49025* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

MORPHOMETRIC STUDIES OF HEAVY ION DAMAGE IN THE BRAINS OF RODENTS

L. M. KRAFT (NASA, Ames Research Center, Moffett Field, CA) and A. B. COX (Colorado State University, Fort Collins) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 251-256.

(Contract NCC2-227)

The relative biological effectiveness (RBE) of different heavy ions for the mammalian brain was determined in mice irradiated at 100 days of age with He-4, C-12, Ne-20, Fe-56, Ar-40, or Co-60 gamma photons (with the primary particle LET values ranging from 2 to 650). Brain preparations were examined 16 months later for volume changes in the external plexiform layer (P-zone) of the olfactory bulb and an internal region (G-zone), which consists of the granule cells, the internal plexiform layer, and the mitral cell layer. The result indicate that the volume changes did occur in the olfactory bulb, not only in absolute terms but also when expressed as the ratio of the structures to each other and to the bulb as a whole. While the observed increased neuronal loss in mice receiving 700 cGy of Co-60 support the earlier data from irradiated rabbits, the increases observed in bulbar volumes and in the volume ratios of the P and the G zones measured in the mice given lower doses (320 or 160 cGy of He or C), were not expected. I.S.

A87-49027**ANIMAL STUDIES OF LIFE SHORTENING AND CANCER RISK FROM SPACE RADIATION**

D. H. WOOD, M. G. YOCHMOWITZ, K. A. HARDY, and Y. L. SALMON (USAF, School of Aerospace Medicine, Brooks AFB, TX) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 275-283. refs

The lifetime effects of simulated space radiation were investigated using as subjects 301 rhesus monkeys (with 57 age-matched controls) exposed to single total doses of one of the following types and energies of radiation: protons (32; 55; 138; 400; 2300; and 10 and 100, in a ratio of 9:1 MeV), electrons (2 and 1.6 MeV), and X-rays (2 MeV). The life expectancy loss from the exposure to protons in the energy ranges encountered

in solar proton events and Van Allen belts was found to be a logarithmic function of the dose, with cancer and endometriosis being the primary causes of premature death. The data from this study, together with human cancer incidence figures and the estimates of the doses at Hiroshima and Nagasaki, indicate a need for limiting the individual career bone marrow exposure for males to 200 rem (from the present-day limit of 400 rem). I.S.

A87-49028
CATARACT ANALYSIS AND THE ASSESSMENT OF RADIATION RISK IN SPACE

B. V. WORGUL (Columbia University, New York) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 285-293. refs
(Contract NIH-EY-02648)

The cataractogenic potential of 540 MeV/amu Ar ions administered to rats in both single and protracted doses was investigated. Following the progress of cataractogenesis and of associated cytopathological damage, it was found that, as the dose of the heavy-particle irradiation decreased, the relative biological effectiveness increased. Fractionating the exposures caused a dose-dependent enhancement in the time of the onset of lens opacification. The cytopathological damage caused by heavy particles was qualitatively (but not quantitatively) identical to the effects of low-LET radiation. It is suggested that, when considering the exposure of the lens to heavy particles, a Quality Factor of at least 40 should be applied. I.S.

A87-49029* Colorado State Univ., Fort Collins.
CATARACTOGENIC POTENTIAL OF IONIZING RADIATIONS IN ANIMAL MODELS THAT SIMULATE MAN

J. T. LETT, A. B. COX, and A. C. LEE (Colorado State University, Fort Collins) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 295-303. refs
(Contract NAG9-10; F33615-85-C-4514)

Aspects of experiments on radiation-induced lenticular opacification during the life spans of two animal models, the New Zealand white rabbit and the rhesus monkey, are compared and contrasted with published results from a life-span study of another animal model, the beagle dog, and the most recent data from the ongoing study of the survivors from radiation exposure at Hiroshima and Nagasaki. An important connection among the three animal studies is that all the measurements of cataract indices were made by one of the authors (Lee), so variation from personal subjectivity was reduced to a minimum. The primary objective of the rabbit experiments (radiations involved: Fe-56, Ar-40, and Ne-20 ions and Co-60 gamma photons) is an evaluation of hazards to astronauts from Galactic particulate radiations. An analogous evaluation of hazards from solar flares during space flight is being made with monkeys exposed to 32, 55, 138 and 400-MeV protons. Conclusions are drawn about the proper use of animal models to simulate radiation responses in man and the levels of radiation-induced lenticular opacification that pose risks to man in space. Author

A87-49034
MOLECULAR EVOLUTION OF LIFE; PROCEEDINGS OF THE CONFERENCE, LIDINGO, SWEDEN, SEPT. 8-12, 1985

HERRICK BALTSCHOFFSKY, ED. (Stockholm, Universitet, Sweden), HANS JORNVALL, ED., and RUDOLF RIGLER, ED. (Karolinska Institutet, Stockholm, Sweden) Conference supported by the Kungliga Vetenskapsakademien, Medicinska Forskningsradet, Naturvetenskapliga Forskningsradet, et al. Cambridge, England and New York, Cambridge University Press, 1986, 378 p. For individual titles see A87-49035 to A87-49049.

Topics discussed include prebiotic systems and evolutionary pathways, nucleic acids and informational systems, proteins and enzymatic functions, and complex systems and organization. Papers are presented on the current status of the prebiotic synthesis of small molecules, the physical basis of molecular evolution, the meaning of selective advantage in macromolecular evolution, the origins of life and the molecular evolution of present-day genes, and the pathways of information readout in DNA. Consideration is also given to the evolution of human loci for small nuclear RNAs; the evolution of ionic channels, hormones, and isozymes; glutathione and the evolution of enzymes for detoxication of the products of oxygen metabolism; and evolutionary relationship between metal centers in cytochrome oxidase and blue oxidases. Attention is also given to the rapid generation of genomic change as a result of overreplication, the structure of a human common cold virus and its evolutionary relations to other viruses, and experiments on the evolution of bacteria with novel enzyme activities. I.S.

A87-49036
THE PHYSICS OF MOLECULAR EVOLUTION

MANFRED EIGEN (Max-Planck-Institut fuer biophysikalische Chemie, Goettingen, West Germany) IN: *Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985*. Cambridge, England and New York, Cambridge University Press, 1986, p. 13-26. refs

Theories relevant to the major steps in the origin and evolution of life are examined from the viewpoint of the physics of molecular evolution and presented in a form which applies to self-replicable macromolecules. The complex structure of the mutant distribution that constitutes the 'quasi-species' is elaborated. According to the modern theory, evolutionary change in the DNA- or RNA-sequence of a gene can be mapped as a trajectory in a 'sequence space' of the dimension ν , where ν corresponds to the number of changeable positions in the genomic sequence. Selection is equivalent to an establishment of the quasi-species in a localized region of sequence space, subject to threshold conditions for the error rate and sequence length. Experimental evidence for this modification of the simple 'chance and law' nature of the Darwinian concept is presented. The results of the theory are being applied to the construction of a machine that provides optimal conditions for a rapid evolution of functionally active macromolecules. I.S.

A87-49037
THE PHYSICAL BASIS OF MOLECULAR EVOLUTION

PETER SCHUSTER (Wien, Universitaet, Vienna, Austria) IN: *Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985*. Cambridge, England and New York, Cambridge University Press, 1986, p. 27-41. Research supported by the Stiftung Volkswagenwerk and Hochschuljubilaeumsstiftung der Stadt Wien. refs
(Contract FFWF PROJECT 5286)

The dynamics of molecular evolution is described by a sequence of kinetic equations of polynucleotide replication which are consistent with the results obtained on the in vitro replication of a virus-specific RNA. According to this dynamical model, the selection and local optimization of mean fitness occur only in special systems with strong constraints on the rate constants; one special case of this type is Fisher's selection equation of population genetics. The relevance of this molecular evolution model for the chemical and the early biological evolutions is discussed. I.S.

A87-49038**DARWINIAN EVOLUTION OF SELF-REPLICATING RNA**

CHRISTOF K. BIEBRICHER (Max-Planck-Institut fuer biophysikalische Chemie, Goettingen, West Germany) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 51-57. refs

The in vitro self-replicating system of short-chain RNA by Q-beta replicase was used as a model in a study of evolution and Darwinian selection. Analytical treatment led to mathematical equations describing the experimental observations. The incorporation profiles simulated in the computer showed excellent agreement with the measured profiles. In the absence of extraneously added template, Q-beta replicase was able, after a long lag time, to synthesize self-replicating RNA de novo. In the absence of a pyrimidine nucleoside triphosphate, a slow accumulation of a mixture of oligonucleotides was observed. Q-beta replicase was also shown to be able to modify a template RNA by condensing nucleotides at its 3-prime end. These slow reactions are thought to be related to the de novo RNA synthesis in vivo. I.S.

A87-49039**COMPARATIVE SEQUENCE ANALYSIS EXEMPLIFIED WITH tRNA AND 5S rRNA**

RUTHILD WINKLER-OSWATITSCH, ANDREAS DRESS, and MANFRED EIGEN (Max-Planck-Institut fuer biophysikalische Chemie, Goettingen, West Germany) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 59-66. refs

The criteria and methods for studying the evolutionary history of RNA on a quantitative basis are developed. It is shown how to obtain an optimal alignment of sequences, determine the topology of their kinship relations, reconstitute precursors, and establish their randomization. The criteria developed are tested by comparison with a large bulk of data on tRNA and 5S rRNA sequences. The master sequence could be obtained from the superposition of all sequences under consideration, counting the most frequent nucleotide at each position. Ancestral features such as base compositions and periodic sequence patterns could be restored. Both tRNA and 5S rRNA sequences were found to have an abundance of RNY triplet patterns (where R stands for purine, N for any of the four nucleotides, and Y for pyrimidine). The data suggest that tRNA and 5S rRNA evolved concomitantly, with an early genetic code favoring codons of the RNY form. I.S.

A87-49040**ORIGINS OF LIFE AND MOLECULAR EVOLUTION OF PRESENT-DAY GENES**

JOHN C. W. SHEPHERD (Basel, Universitaet, Switzerland) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 75-83. SNSF-supported research. refs

Purine-pyrimidine correlations from present-day DNA sequences support the hypothesis that a comma-less coding system (i.e., only readable in one frame) was used in the earliest self-replicating systems as life originated on earth. The indications are that the primeval coding triplets had the form RNY (R = purine, Y = pyrimidine and N = purine or pyrimidine), providing codons for a maximum of eight amino acids on the basis of the present genetic code. Corroborative evidence for this hypothesis is obtained by examining the mutated relics of such messages in present genomes. These relics are most clearly seen in genes which are known to have been stable over long periods of time, and in genes coding for plentiful proteins, which have been long subject to restrictions preserving some features of their primeval codon usage. With the start point provided by the hypothesis, indicative simulations can be made of possible paths for subsequent mutation over the whole period of evolutionary time. Such simulations suggest a period of considerable functional improvement in which the majority of the mutations occurring are

accepted, followed by one in which most mutations are rejected and only minor further improvements can be made. Author

A87-49041**EVOLUTIONARY ASPECTS OF UNCONVENTIONAL CODON READING**

ULF LAGERKVIST (Goteborg, Universitet, Sweden) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 85-89. refs

In experiments with in vitro protein synthesizing systems, Lagerquist and coworkers (1977, 1979, 1980, 1981, and 1983) obtained evidence that codon readings may involve all the base combinations forbidden by the wobble rules of Crick (1966). Moreover, it was found that as a group, the 'family codons' were considerably more amenable to unconventional reading than were the 'nonfamily' codons. Hypothetical mechanisms of such unconventional codon readings are discussed together with their possible role in the cell's normal translational performance and in the evolution of the translational apparatus. I.S.

A87-49042**TRANSFER RNA MODIFICATION IN DIFFERENT ORGANISMS**

GLENN R. BJORK (Umea Universitet, Sweden) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 91-95. Research supported by the Swedish Cancer Society, Swedish National Science Foundation, and Styrelsen for Teknisk Utveckling. refs

Transfer RNA from all organisms so far investigated contains modified nucleosides, formed during the maturation of the tRNA after the primary transcript is made. Using the known sequence of about 250 tRNA species from the eukaryotes, eubacteria, and archaeobacteria kingdoms, the pattern of modification in each position of these tRNAs was examined. It was found that tRNA from each kingdom contain group-specific modifications, with some modified nucleosides unique to eukaryotes, eubacteria, or archaeobacteria, respectively. On the other hand, some are present at comparative positions in tRNAs from all three kingdoms, suggesting either that convergent evolution of the formation of these modified nucleosides has occurred or that these nucleosides were present in the tRNA of the common ancestor. I.S.

A87-49043**CONFORMATIONAL DYNAMICS AND EVOLUTION OF tRNA STRUCTURE**

RUDOLF RIGLER, FLORA CLAESENS, and LENNART NILSSON (Karolinska Institutet, Stockholm, Sweden) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 103-107. Research supported by the Swedish Science Research Council, Karolinska Institutet, and the K. and A. Wallenberg Foundation. refs

Experiments with pulsed laser sources and high-resolution NMR, used in the molecular structure studies of an anticodon-loop-stem fragment of tRNA samples containing wybutine at position 37, clearly show that the anticodon loop is able to assume different conformations, which depend on the tertiary structure of the codon offered. It is suggested that the anticodon loop of tRNA, when interacting with a codon, exists in a conformation different from the canonical 3-prime-5-prime stack of the anticodon triplet and that a 5-prime-3-prime stack of the anticodon triplet exists in a dynamic equilibrium with the 3-prime-5-prime form. I.S.

**A87-49044
EVOLUTIONARY ASPECTS OF RIBOSOME-FACTOR INTERACTIONS**

A. LILJAS, S. THIRUP (Uppsala Universitet, Sweden), and A. T. MATHESON (Victoria, University, Canada) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 109-119. refs

The protein synthesis machinery provides a rich source for studies of evolutionary relationships. This paper reviews the relationship between a number of protein factors that bind to the ribosomes at various stages of protein synthesis. The factors involved in GTP binding and hydrolysis clearly have one domain in common which could have originated from a common ancestor. The homology outside this GTP binding domain is less significant. Two release factors that interact with the same region of the ribosome manifest only a low level of homology with the other factors. One ribosomal protein that interacts with all these factors has been characterized from a variety of organisms. The amino acid sequences from the eucaryotic forms of this protein can easily be aligned with the ones from archaebacteria but not with eubacterial proteins. Furthermore, the localization of a hinge region and a number of characteristic structural features suggests that the C-terminal domain in eubacteria is transposed to the N-terminus in eucaryotes and archaebacteria. This identification may indicate that there was an early divergence of these proteins. Despite this dramatic alteration in the amino acid sequence it is possible to arrange the two forms of the protein in a similar manner within the ribosome. Author

**A87-49045
EVOLUTION MAPPED WITH THREE-DIMENSIONAL RIBOSOME STRUCTURE**

J. A. LAKE, E. HENDERSON, M. W. CLARK, A. SCHEINMAN, and M. I. OAKES (California, University, Los Angeles) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 121-126. refs
(Contract NSF PCM-83-16926; NIH-GM-24034)

Three-dimensional ribosomal structure is highly conserved, even when organisms from different kingdoms are compared. In general, ribosomal large and small subunits are organized in four structural patterns. By using a parsimony analysis of ribosome structure, two results were found that stand in contrast with the standard evolutionary tree. First, it was found that the sulfur-dependent bacteria, or eocytes, are topologically nearest neighbors to the eukaryotes rather than to the methanogens. It is suggested that the depth of this division is appropriate for a separation at the kingdom level. Secondly, the data indicate that the halobacteria have diverged from the eubacteria more recently than from any other known group of organisms. These results indicate that the halobacteria are incorrectly placed in the archaebacteria, and should probably be included with the eubacteria into a larger group, the photocytes. Author

**A87-49046
INORGANIC PYROPHOSPHATE AND THE MOLECULAR EVOLUTION OF BIOLOGICAL ENERGY COUPLING**

H. BALTSCHIEFFSKY, M. LUNDIN, C. LUXEMBURG, P. NYREN, and M. BALTSCHIEFFSKY (Stockholm, Universitet, Sweden) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 259-262. refs

The only known alternative (to ATP) source of biological energy is inorganic pyrophosphate (PPi). In this paper, the properties of the corresponding alternative coupling factor, the membrane-bound proton-pumping PPase, H(+)-PPase, are described. The H(+)-PPase was solubilized from chromatophores of *Rhodospirillum rubrum* and from yeast mitochondrial membranes; its presence was also detected in rat liver. The structural and metabolic properties of this alternative energy coupling system indicate that this system may have preceded the H(+)-ATP synthase in biological evolution. I.S.

**A87-49047
EVOLUTION OF ATP SYNTHASE**

J. E. WALKER and A. L. COZENS (Medical Research Council, Laboratory of Molecular Biology, Cambridge, England) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 263-272. refs

Studies of the subunits and their genes of the ATP-synthase from eubacteria, mitochondria, and chloroplasts are reviewed in an effort of establishing the origins of mitochondria and chloroplasts. Comparisons of both the order and sequences of genes for the eight subunits of ATP synthase from chloroplasts and from *Synechococcus* bacteria are consistent with the hypothesis that the chloroplast and the cyanobacteria genomes are part of the same evolutionary and taxonomic group. The information presently available on the nuclear genes for the mitochondrial enzyme complex is not sufficient to provide evidence for or against a symbiotic origin of mitochondria. I.S.

**A87-49048
STRUCTURAL, FUNCTIONAL AND EVOLUTIONARY ASPECTS OF PROTON-TRANSLCATING ATPASE**

L. ERNSTER, T. HUNDAL, B. NORLING, G. SANDRI, L. WOJCZAK (Stockholm, Universitet, Sweden) et al. IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 273-279. refs

Recent information concerning the proton-translocating F₀F₁-ATPase and, in particular, its two specifically mitochondrial subunits, the oligomycin-sensitivity-conferring protein and the coupling factor F₆, is discussed, with emphasis on their structural, functional, and evolutionary relationship to other subunits of the mitochondrial and bacterial ATPase systems. Evidence is presented suggesting a possible common evolutionary origin of those subunits of the mitochondrial F₀F₁-ATPase which are of special functional importance for the mitochondrial energy-transducing system. The data also reveal a structural homology between the catalytic centers of the F₀F₁-ATPase and the E1E2-ATPase, suggesting a common evolutionary origin of the enzymes involved in proton-motive ATP synthesis and in ATP-driven cation transport. I.S.

**A87-49049
EXPERIMENTS ON THE EVOLUTION OF BACTERIA WITH NOVEL ENZYME ACTIVITIES**

PATRICIA H. CLARKE (University College, London, England) IN: Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985. Cambridge, England and New York, Cambridge University Press, 1986, p. 337-342. refs

Bacteria have been shown to be able to evolve new metabolic activities under laboratory conditions. The genetic events concerned include mutations in enzyme structural genes resulting in altered enzymes, mutations in regulator genes producing higher enzyme levels, activation of cryptic genes, the acquisition of plasmids and the transfer of genes between species. Author

**A87-49215
PAIN AND ENDOGENOUS ANALGESIC MECHANISMS IN THE ORGANISM'S ADAPTIVE ACTIVITY [BOL' I ENDOGENNYE ANALGETICHESKIE MEKHANIZMY V PRISPOBITEL'NOI DEIATEL'NOSTI ORGANIZMA]**

IU. V. BUROV and E. A. KIIATKIN (AMN SSSR, Institut Farmakologii, Moscow, USSR) Akademii Nauk SSSR, Izvestiia, Serii Biologicheskaiia (ISSN 0002-3329), May-June 1987, p. 413-423. In Russian. refs

Studies concerning the neurochemical and neurophysiological mechanisms activated by pain and stress stimuli and the natural regulation of these mechanisms are discussed. Consideration is given to the role of pain in the organism's activity and to the adaptive changes (such as evasion and self-protective aggression, and an increase in tolerance) effected by particular stressful stimuli. Special attention is given to the antinociceptive mechanisms responsible for the observed pain- and stress-induced effects. I.S.

A87-49677

GAS REGIMEN OF AN ORGANISM DURING ADAPTATION AND DEADAPTATION TO INTERMITTENT HYPOBARIC HYPOXIA [GAZOVYI REZHIM ORGANIZMA V PERIOD ADAPTATSII I DEADAPTATSII K PRERYVISTOI GIPOBARICHESKOI GIPOKSII]

V. A. VORONTSOV and N. R. RUSANOVA (Ministerstvo Zdravookhraneniia RSFSR, Orenburgskii Meditsinskii Institut, Orenburg, USSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, May-June 1987, p. 33-38. In Russian. refs

Thirty parameters of the body oxygen supply system were studied in rats during adaptation to intermittent hypobaric hypoxia in a pressure chamber at a simulated altitude of 5000 mm followed by deadaptation at sea level. Changes observed in the blood acid-base balance, the physicochemical characteristics of erythrocytes, hemoglobin concentration, and the O₂ and CO₂ indices of arterial and venous blood after 1, 3, 7, 14, 21, and 30 days at the simulated altitude and during the same periods of subsequent deadaptation were of complex nature and at times appeared inconsistent. I.S.

A87-49678

A STUDY OF THE RELATIONSHIP BETWEEN THE RESISTANCE OF RATS TO ACUTE HYPOXIC HYPOXIA AND THE ACTIVITY OF THE LIVER MICROSOMAL OXIDATION SYSTEM [ISSLEDOVANIE SVIAZI MEZHDU USTOICHIVOST'IU KRYS K OSTROI GIPOKSICHESKOI GIPOKSII I AKTIVNOST'IU MIKROSOMAL'NOI SISTEMY OKISLENNIIA PECHENI]

L. A. GORCHAKOVA (AN USSR, Institut Fiziologii, Kiev, Ukrainian SSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, May-June 1987, p. 53-58. In Russian. refs

A87-49679

THE FEATURES OF OXYGEN TRANSPORT TO TISSUES DURING SHORT-TERM AND LONG-TERM ADAPTATION TO HIGH ALTITUDE [OSOBENNOSTI TRANSPORTA KISLORODA K TKANIAM V PERIOD KRATKOVREMENNOI I DLITEL'NOI ADAPTATSII K VYSOKOGOR'IU]

M. V. BALYKIN, KH. D. KARKOBATOV, and IU. KH.-M. SHIDAKOV (AN KSSR, Institut Fiziologii i Eksperimental'noi Patologii Vysokogor'ia, Frunze, Kirgiz SSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, May-June 1987, p. 92-96. In Russian. refs

The role of the circulatory system in long-term and short-term adaptation to high-altitude hypoxia was investigated using adult dogs born and living at the altitude of 2700 m and those born at sea level but transported to the elevated altitude seven days before the experiment. The O₂ and CO₂ pressures of arterial and venous blood as well as the parameters of the acid-base condition were determined in blood in catheterized cardiac cavities. It was found that during short-term exposure to high altitude, oxygen supply was maintained by an increase in O₂ transport to tissues through intensification of circulation (indicated by elevated heart rate and minute blood volume). In dogs native to the high altitude the O₂ demand was satisfied by relatively more effective peripheral O₂ utilization on the background of low circulation intensity (low heart rate and minute blood volume). I.S.

A87-50312

LACK OF BUBBLE FORMATION IN HYPOBARICALLY DECOMPRESSED CELLSEDVARD A. HEMMINGSEN, BARBARA B. HEMMINGSEN, JAN O. OWE, and HARALD T. ANDERSEN (Institute of Aviation Medicine, Oslo, Norway) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 742-746. Research supported by Storebrand-Norden and Den Norske Creditbank. refs
(Contract N00014-85-G-0152; NIH-HL-16855)

Suspensions of human erythrocytes or of unicellular microorganisms (*Tetrahymena pyriformis*, *Euglena gracilis*, *Escherichia coli*, and *Microcycilus aquaticus*) were equilibrated with nitrogen gas pressures up to 200 atm and rapidly decompressed to hypobaric pressures below the vapor point of water. The

intracellular environments proved to be very tolerant to the gas supersaturations induced. None or only a few cells were damaged in each case, and bubbles were never observed intracellularly after decompression. In view of such extreme tolerances, it is doubtful that bubbles originate intracellularly during decompression of multicellular organisms, in which bubbles occur with far lower gas supersaturations, unless the tolerances are greatly affected by extensive mechanical deformations of the cells or by the presence of internalized particles with bubble-promoting properties. Author

A87-50394

BLOOD ADENYL NUCLEOTIDES IN EVALUATION OF THE METABOLISM OF ANIMALS SUBJECTED TO HYPOKINESIA AND EXPOSED TO THE EFFECT OF POSITIVE OR NEGATIVE IONS IN AIR [NUKLEOTYDY ADENILOWE WE KRWI W OCENIE METABOLIZMU ZWIERZAT W HIPOKINEZJI I EKSPONOWANYCH NA DZIALANIE DODATNICH LUB UJEMNYCH JONOW POWIETRZA]

RYSZARD BERNAT and ALMA GROCHOWALSKA (Akademia Medyczna, Zaklad Fiziologii, Poznan, Poland) Postepy Astronautyki (ISSN 0373-5982), vol. 19, no. 3-4, 1986, p. 79-88. In Polish. refs

The concentrations of ATP, ADP, AMP, glucose, and free fatty acids were measured in the blood of rats immobilized for three weeks and simultaneously exposed to positive or negative ions generated in air by a BION-type ionizer. Metabolic changes were estimated by calculating the values of the energy charge potential and the phosphorylation potential. The results indicate that exposure to positive air-ions amplifies the rise of catabolism due to hypokinesia. Negative ions had no effect. I.S.

A87-50395

SITUATIONAL AND INDIVIDUAL DETERMINANTS OF PSYCHO-PSYCHOLOGICAL CHANGES UNDER ANTICIPATION-RELATED STRESS [SYTUACYJNE I INDYWIDUALNE WYZNACZNIKI ZMIAN PSYCHOFIZJOLOGICZNYCH W WARUNKACH ANTY-CYPOWANEGO STRESU]

TYTUS SOSPANSKI, WLODZIMIERZ ONISZCZENKO, and JAN STRELAU (Warszawa, Uniwersytet, Warsaw, Poland) Postepy Astronautyki (ISSN 0373-5982), vol. 19, no. 3-4, 1986, p. 89-117. In Polish. Research supported by the Polska Akademia Nauk and Wojskowy Instytut Medycyny Lotniczej. refs

The effects of situational and individual factors on changes in heart rate and skin conductance, as indices of the psychophysiological state, were studied in subjects exposed to different stress conditions. The adverse stimuli were represented by electrical shock expected to occur after time periods which were either predetermined or not known to the subjects, or by an unexpected electrical shock or a powerful sound. The usefulness of measuring heart rate and skin conductance to assess the psychological state of humans under anticipation-related stress is discussed. I.S.

N87-27380#

Pennsylvania State Univ., University Park. Cooperative Program in Biotechnology.

SYMPOSIUM AND WORKSHOP SUPPORT IN MOLECULAR BIOLOGY AND BIOTECHNOLOGY (5TH) HELD IN UNIVERSITY PARK, PENNSYLVANIA ON FEBRUARY 5, 1986 AND JULY 30 - AUGUST 1, 1986 Final Technical Report, 1 Sep. 1985 - 28 Feb. 1987

S. E. STEVENS, JR. 29 Apr. 1987 25 p Symposium held in University Park, Pa., 5 Feb. and 30 Jul. - 1 Aug. 1986 (Contract AF-AFOSR-0338-85) (AD-A181190; AFOSR-87-0714TR) Avail: NTIS HC A02/MF A01 CSDL 06B

The Cooperative Program in Biotechnology held the Fifth Winter Workshop, the Fifth Summer Symposium in Molecular Biology and will present the Sixth Summer Symposium in Molecular Biology in 1987 under the auspices of the AFOSR. The Fifth Winter Workshop was an open meeting without registration and was attended by

about 200 people. This paper consists of a schedule of events and a pre-registration list. GRA

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and weightlessness.

A87-48157

THE PROBLEM OF RADIATION EXPOSURE IN THE SPACE STATION [DAS PROBLEM DER STRAHLENBELASTUNG IN DER RAUMSTATION]

H. BUECKER and G. REITZ (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) IN: Yearbook 1986 II; DGLR, Annual Meeting, Munich, West Germany, Oct. 8-10, 1986, Reports. Bonn, Deutsche Gesellschaft fuer Luft- und Raumfahrt, 1986, p. 504-512. In German. refs (DGLR PAPER 86-175)

The radiation environment at the Space Station orbit is characterized, summarizing data obtained on Spacelab D1 and other earlier missions, and its implications for the design and use of the Space Station are considered. Consideration is given to the principal radiation sources (solar-wind and solar-flare protons, auroral protons and electrons, trapped protons and electrons, and Galactic cosmic rays); the frequency of South Atlantic Anomaly (SAA) crossings by the Space Station; the relative biological effectiveness of the different radiation types; linear-effective-transit spectra for space missions since Apollo 16; and D1 Biorack results. It is estimated that the 50-rem maximum annual dose recommended by the National Committee of Radiation Protection (1975) would be reached after 172 days on the Space Station, even if the SAA uncertainties, the effects of microgravity on radiation sensitivity, and solar flares are not taken into account. T.K.

A87-49022

LEARNING DISABILITIES IN INDIVIDUALS EXPOSED PRENATALLY TO IONIZING RADIATION - THE HIROSHIMA AND NAGASAKI EXPERIENCES

WILLIAM J. SCHULL (Texas, University, Houston) and MASANORI OTAKE (Radiation Effects Research Foundation, Hiroshima, Japan) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 223-232. Research supported by the Japanese Ministry of Health and Welfare, U.S. National Research Council, National Academy of Sciences, and DOE. refs

The results of analyses on the occurrence of mental retardation among the individuals prenatally exposed to ionizing radiation in Hiroshima and Nagasaki are presented. The data suggest that severe mental retardation occurs primarily upon exposure in the period from the 8th to 15th week following fertilization; the increase in mental retardation is linear with dose and without a threshold. More subtle functional effects were also observed, as reflected in diminished performance on intelligence tests and in school. I.S.

A87-49026* California Univ., Berkeley.

RADIATION ENVIRONMENTS AND ABSORBED DOSE ESTIMATIONS ON MANNED SPACE MISSIONS

S. B. CURTIS (California, University, Berkeley), W. ATWELL, R. BEEVER (Rockwell International Corp., Houston, TX), and A. HARDY (NASA, Johnson Space Center, Houston, TX) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 269-274. refs

The dose and dose-equivalent estimates that astronauts might be expected to receive in space were assessed for the development of new radiation protection guidelines, considering several space mission scenarios. These scenarios included a 90-day LEO mission at 450 km altitude with orbital inclinations appropriate for NASA's Space Station (28.5, 57, and 90 deg), a 15-day sortie to GEO, and a 90-day lunar mission. All the missions contemplated would present space travelers with dose equivalents between 5 and 10 rem to the blood-forming organs, assuming no encounter with a large solar particle event; a large particle event could add considerable exposure for all scenarios except for the one at 28.5 orbital inclination. Adequate shielding must be included to guard against the radiation produced by such events. I.S.

A87-49676

VENTILATORY RESPONSE TO A HYPERCAPNIC STIMULUS AS A REACTIVITY INDEX OF THE HUMAN RESPIRATORY SYSTEM [VENTILATORNIY OTVET NA GIPERKAPNICHESKII STIMUL KAK POKAZATEL' REAKTIVNOSTI SISTEMY DYKHANIYA CHELOVEKA]

V. A. BEREZOVSKII and T. V. SEREBROVSKAIA (AN USSR, Institut Fiziologii, Kiev, Ukrainian SSR) Fiziologicheskii Zhurnal (Kiev) (ISSN 0201-8489), vol. 33, May-June 1987, p. 12-18. In Russian. refs

A method is described for testing the respiratory system reactivity in humans by measuring hypercapnic ventilatory drive in male subjects (untrained adults and teenagers and athletes) subjected to hypercapnic stimuli of low and high intensity. Several types of the ventilatory response, characteristic for teenagers, athletes, and untrained adults were identified on the basis of the value of Pa(CO₂) at which the rate of the ventilatory reaction increased abruptly. A correlation analysis shows that the subjects who exhibit the rate increase at higher values of Pa(CO₂) are characterized by low metabolic rate, relatively low responses of the respiratory and circulatory systems to moderate physical load, elevated responses to maximal load, increased tolerance to pH shifts in blood, and an increased work capacity both at sea level and in the mountains. I.S.

A87-49680

DYNAMICS OF TOPOGRAMS OF HUMAN NEOCORTEX POTENTIALS AT REST AND AT DIFFERENT STAGES OF ACTIVITY [DINAMIKA TOPOGRAMM POTENTIALOV NEOKORTEKSA CHELOVEKA V POKOE I NA RAZLICHNYKH ETAPAKH DEIATEL'NOSTI]

I. N. KNIPST, A. V. KORINEVSKII, N. S. KUROVA, and O. V. DASHKEVICH (AN SSSR, Institut Vyshei Nervnoi Deiatel'nosti i Neirofiziologii, Moscow, USSR) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 13, May-June 1987, p. 396-404. In Russian. refs

The changes in the temporal-spatial organization of potentials (TSOP) in the human neocortex, effected at various stages of execution of an assignment, were measured in subjects equipped with 24 electrodes over the left hemisphere. The TSOP parameters were registered after short adaptation to the experimental environment, during the instruction period, after the 'ready' signal, and immediately after the subjects' motor reaction to the command, when the subjects were informed about the results of the test. Two types of cortex TSOP were detected in the delta rhythm range during various stages of the subjects' activity: (1) an inversion of the saggital gradient of potentials and (2) widely distributed

synchronized unidirectional and similar-amplitude fluctuations of potentials. I.S.

A87-49681

OCULOMOTOR CONTROL OF PHYSICAL EFFORT UNDER HYPERTHERMIA [ZRITEL'NO-MOTORNYI KONTROL' FIZICHESKOGO USILIIA PRI GIPERTERMII ORGANIZMA]

V. A. KUZ'MENKO (AMN SSSR, Nauchno-Issledovatel'skii Institut Normal'noi Fiziologii, Moscow, USSR) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 13, May-June 1987, p. 425-431. In Russian. refs

The effect of hyperthermia on the quality of muscular effort was studied in human male subjects performing a simple physical work assignment (compressing a rubber bulb to effect the movement of a pointer to a certain mark on a scale) before and after being subjected to hyperthermia (80-85 C for 8-12 min each time for 5-6 times with week-long intervals). Body temperature, hemodynamic indices, and respiration parameters served as indicators of the organism's condition. Hyperthermia caused an increase in the integral error in the regulation of the physical effort. The degree of the deterioration of the oculomotor control of an individual could vary widely; it was inversely proportional to the value of the initial error in regulation. In addition, the degree of deterioration depended on heart activity: regardless of the initial regulation ability, the increase in error due to hyperthermia was less pronounced on days when a subject's heart activity was lowered by hyperthermia. I.S.

A87-49682

AMPLIFYING THE EFFECT OF OXYGEN ON THE ORGANISM IN THE PRESENCE OF HELIUM [OB USILENII VLIANIYA KISLORODA NA ORGANIZM V PRISUTSTVII GELIIA]

M. M. SEREDENKO and E. V. ROZOVA (AN USSR, Institut Fiziologii, Kiev, Ukrainian SSR) Fiziologiya Cheloveka (ISSN 0131-1646), vol. 13, May-June 1987, p. 463-468. In Russian. refs

The effect of replacing nitrogen by helium in oxygen-containing mixtures on the parameters of respiratory activity and alveolar gas exchange was investigated in 105 normal human subjects breathing (for 20 min) mixtures of 40, 21, 14.5, and 11 percent O₂ in N₂ or He. In addition, 78 subjects with chronic pulmonary insufficiency were tested at 40 and 21 percent O₂ in N₂ or He. Helium (compared to nitrogen) was found to increase the effect of relative oxygen concentration on the organism, ameliorating the effect of hypoxia. The use of normal oxygen concentration (21 percent) in helium mixtures caused symptoms of hyperoxia. I.S.

A87-50314

EFFECTS OF HYDRAULIC RESISTANCE CIRCUIT TRAINING ON PHYSICAL FITNESS COMPONENTS OF POTENTIAL RELEVANCE TO +GZ TOLERANCE

IRA JACOBS, DOUGLAS G. BELL, JAN POPE, and WAYNE LEE (Defence and Civil Institute of Environmental Medicine, Toronto, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 754-760. refs

A strength-training program for high-performance aircraft crew, designed to improve +Gz acceleration tolerance, is described. The 12 weeks of training involved hydraulic resistance circuit training 2-4 times/week. The following variables were measured: maximal strength of several large muscle groups during isokinetic contractions, maximal aerobic power and an endurance fitness index, maximal anaerobic power, anthropometric characteristics, and maximal expiratory pressure generated during exhalation. The exercise:rest ratio was 20:40 s for the first 4 weeks, and was then increased to 30:50 s. The training was found to induce small, but significant, increases in maximal strength of several large muscle groups, as well as significant improvements of the indicators of endurance fitness. Neither maximal anaerobic power (i.e., muscular endurance) nor maximal expiratory pressure were changed. I.S.

A87-50315

ANAEROBIC ENERGETICS OF THE SIMULATED AERIAL COMBAT MANEUVER (SACM)

RUSSELL R. BURTON, JAMES E. WHINNERY, and ESTRELLA M. FORSTER (USAF, School of Aerospace Medicine, Brooks AFB; Rothe Development, Inc., San Antonio, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 761-767. refs

The role of anaerobic metabolism in +Gz duration tolerance was measured using venous blood lactate concentrations before G exposure and after subjects had been fatigued from exposure to one of several levels of G: low (4.5 G) sustained G (LSG); high (7-9 G) sustained G (HSG); and simulated aerial combat maneuver (SACM) of 4.5/7 G levels. A mean + or - SE blood lactate of six subjects fatigued from LSG was 29.8 + or - 4.0 mg pct. Four subjects fatigued from HSG had blood lactates of 42.4 + or - 3.2 mg pct, and six had blood lactates of 46.7 + or - 7.2 mg pct from the SACM. Blood lactates appeared to correlate directly (on a group basis) with maximum heart rates found during G exposures. Six subjects exposed to 8 or 9 G for 10 s or less demonstrated an anaerobic alactate capacity. These G findings were related to fatigue produced with isometric muscle contraction in physiologic studies conducted at 1 G. It is concluded that anaerobic metabolism and isometric exercise physiology are directly related to duration tolerances of fatigue at all levels of +Gz.

Author

A87-50316

DECREMENT IN POSTURAL CONTROL DURING MILD HYPOBARIC HYPOXIA

W. D. FRASER, D. E. EASTMAN, M. A. PAUL, and J. A. G. PORLIER (Defence and Civil Institute of Environmental Medicine, Downsview, Canada) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 768-772. refs

The effects of four different mild hypobaric hypoxia exposures (at simulated altitudes of 1521, 2438, 3048, and 3658 m) on the postural control capabilities of human subjects were studied by measuring the postural sway with a Kistler force platform. The values of the total body sway over all frequencies and the sway at the lowest measurable frequency with the eyes closed were compared with the ground level controls. Acute mild hypoxia, even at an altitude as low as 1524 m, was found to produce a significant increase in body sway and an impairment in postural stability, suggesting that more attention should be paid to the effects of mild hypoxia altitude exposure on the vestibular apparatus of pilots. At the highest altitude (3658 m), there was no change from the control levels, indicating an intervention of compensatory mechanisms leading to a recovery of postural stability. I.S.

A87-50317* Brandeis Univ., Waltham, Mass.

TREATMENT OF SEVERE MOTION SICKNESS WITH ANTIMOTION SICKNESS DRUG INJECTIONS

ASHTON GRAYBIEL and JAMES R. LACKNER (Brandeis University, Waltham, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 773-776. refs (Contract NAS9-15147)

This report concerns the use of intramuscular injections of scopolamine, promethazine, and dramamine to treat severely motion sick individuals participating in parabolic flight experiments. The findings indicate that a majority of individuals received benefit from 50-mg injections of promethazine or 0.5 mg-injections of scopolamine. By contrast, 50-mg injections of dramamine and 25-mg injections of promethazine were nonbeneficial. The use of antimotion drug injections for treating space motion sickness is discussed. Author

A87-50320

AIRLINE PILOT MEDICAL DISABILITY - A COMPARISON BETWEEN THREE AIRLINES WITH DIFFERENT APPROACHES TO MEDICAL MONITORING

GEOFFREY W. HOLT, WILLIAM F. TAYLOR, and EARL T. CARTER (Mayo Clinic and Mayo Foundation, Rochester, MN) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 788-791. refs

The impact of airline medical departments on pilot health and medical disability was studied by comparing three major U.S. airlines (nominally A, B, and C) comparable in most regards but having distinctly different medical programs. Airline A was the only one without an active medical department and essentially no medical reviews. Airline B performed preemployment screening and an irregular pilot review, while airline C screened pilots annually (in addition to preemployment screening). The medical disability rates of all three airlines increased rapidly after the pilots reached the age of 45 years. However, the disability rates after 45 were significantly higher for airline A than were those for airlines B and C. The increased disability rate found for airline A could not be related to any one specific disease process. I.S.

A87-50321

EXERCISE-ENHANCED RISK FACTORS FOR CORONARY HEART DISEASE VS. AGE AS CRITERIA FOR MANDATORY RETIREMENT OF HEALTHY PILOTS

ROBERT A. BRUCE and LLOYD D. FISHER (Washington, University, Seattle) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 792-798. Research supported by the Health Resources Administration, University of Washington, and NIH. refs

Exercise-enhanced risk assessment for subsequent morbidity and mortality due to coronary heart disease is examined in 4105 asymptomatic healthy men of 15 to 80 years of age (mean of 44.7 years) observed in Seattle community practice. Annual incidence of primary coronary events averages 0.22 percent in 1792 men (43.6 percent) without conventional risk factors, and 0.42 percent in the majority of men (55.3 percent) with risk factor(s), but less than two abnormal responses to maximal exercise. Among 44 men (1.1 percent) at high risk defined by any conventional risk factor(s) and two or more abnormal responses to maximal exercise, annual incidence of primary coronary events averages 5.2 percent (p less than 0.001). The proportion of men of 60-64 years at low risk with a 98 percent 3-year survival rate is 16 times that of men of 55-59 years at high risk with a 78 percent survival rate in this asymptomatic population. Of 1718 men under 60 years of age and without conventional risk factors, 117 or 6.8 percent developed ischemic ST depression with maximal exercise testing, but none reported any coronary event during 5.6 years of follow-up surveillance. Author

A87-50649#

CHANGES OF PILOTS' SKIN TEMPERATURE IN FLIGHT

HIROHIDE URANO (Fukui Medical School, Japan), HIROTAKA SATAKE, and TAKASHI KAWASHIMA (Gifu University, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 24, March 1987, p. 1-6. refs

The skin temperatures of nine amateur pilots aged 28 to 40 years old were taken in 10 experimental flights from May through December 1986 using thermistors and an analog tape recorder. The temperature went up and down slowly with little delay following changes in cabin air temperature. All crews showed a small fall in skin temperature over one hour of flight. Abrupt drops in temperature overlapped the slow changes. The skin temperature fall during takeoff was 0.6 C lower at level flight in traffic than during taxiing. The same small drop occurred during turbulence or steep turn, but no change was observed during calm cruise. A 0.4-C drop in skin temperature occurred during plane landing even though cabin temperature was rising. Tachycardia and cold sweat were observed simultaneously with the drop in skin temperature. C.D.

A87-50650#

RESPONSE, REGULATION, AND ACTIONS OF ALDOSTERONE AND ANTIDIURETIC HORMONE FOLLOWING HEAT EXPOSURE - COMPARISON WITH EXERCISE-INDUCED RELEASE

MASATO SUZUKI and SATIO IKAWA (Jikei University, Tokyo, Japan) Japanese Journal of Aerospace and Environmental Medicine (ISSN 0387-0723), vol. 24, March 1987, p. 7-17. refs

A study was carried out in healthy male volunteers to investigate the factors simulating aldosterone (Ald) and antidiuretic hormone (ADH) secretion and the actions of these hormones following heat exposure. The differences in the releasing factors and the actions of these hormones between heat exposure and exhaustive exercise were also studied. The plasma concentrations of Ald and ADH were found to increase during heat exposure. The elevation of pAld following heat exposure is mediated primarily by the renin-angiotensin system and ACTH release. Due to elevated Ald secretion, Na(+) reabsorption in the kidney increased. Factors other than a change in serum osmolality or reduction in plasma volume caused the release of ADH in response to heat exposure. Transient increases in pAld and pADH were observed after exhaustive exercise. C.D.

N87-27381*# Rockefeller Univ., New York.

VESTIBULAR SYSTEM AND NEURAL CORRELATES OF MOTION SICKNESS Final Technical Report, 1 Mar. 1982 - 28 Feb. 1986

ALAN D. MILLER 28 Feb. 1986 7 p

(Contract NAG2-164)

(NASA-CR-181185; NAS 1.26:181185) Avail: NTIS HC A02/MF A01 CSDL 06P

Initial studies re-examine the role of certain central nervous system structures in the production of vestibular-induced vomiting and vomiting in general. All experiments were conducted using cats. Since these studies demonstrated that the essential role of various central structures in vestibular-induced vomiting is only poorly understood, efforts were re-directed to study the control of the effector muscles (diaphragm and abdominal muscles) that produce the pressure changes responsible for vomiting, with the goal of determining how this control mechanism is engaged during motion sickness. Experiments were conducted to localize the motoneurons that innervate the individual abdominal muscles and the portion of the diaphragm that surrounds the esophagus. A central question regarding respiratory muscle control during vomiting is whether these muscles are activated via the same brain stem pre-motor neurons that provide descending respiratory drive and/or by other descending input(s). In other experiments, the use of a combination of pitch and roll motions to produce motion sickness in unrestrained cats was evaluated. This stimulus combination can produce vomiting in only the most susceptible cats and is thus not as provocative a stimulus for cats as vertical linear acceleration. Author

N87-27382# Army Research Inst. of Environmental Medicine, Natick, Mass.

MAUNA KEA 3: METABOLIC EFFECTS OF DIETARY CARBOHYDRATE SUPPLEMENTATION DURING EXERCISE AT 4100 M ALTITUDE Final Report, Jul. 1985 - Apr. 1987

E. W. ASKEW, J. W. CLAYBAUGH, G. M. HASHIRO, W. S. STOKES, and A. SATO 1 May 1987 91 p

(AD-A180629; USARIEM-T-12-87) Avail: NTIS HC A05/MF A01 CSDL 06J

Twenty-nine male soldiers were divided into 3 groups to study the effects of exercise and carbohydrate supplementation on physical performance and metabolism at high altitude. All groups were provided a standard military field ration (Meal, Ready-to-Eat) containing 45% carbohydrate (CHO) was consumed ad libitum during 4 consecutive days of residence at an altitude of 4100 M. Two groups (EX and EX + CHO) exercised while at high altitude by running and walking at about 75% maximum heart rate 2h/day. The third group (SED) remained sedentary while at high altitude. One exercise group (EX + CHO) was permitted to consume carbohydrate sweetened beverages ad libitum as a supplement (250 to 350 g CHO/day) to the diet. The other two groups

consumed similar beverages containing a non-caloric sweetener also on an ad libitum basis. Baseline measurements of food consumption, aerobic capacity, and blood and urine metabolites were recorded for all groups during 2 days of sedentary activity at sea level prior to rapid ascent to altitude (4100 M). Mean daily caloric intakes during the 4 days of exercise at altitude were 1513 kcal (SED), 1787 kcal (EX), and 2325 kcal (EX+CHO). The EX+CHO group consumed an average of 404 g CHO/day compared to 187 and 159 g CHO/day for the EX and SED groups respectively. GRA

N87-27383# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.

A STUDY OF PASSENGER WORKLOAD AS RELATED TO PROTECTIVE BREATHING REQUIREMENTS Final Report

E. A. HIGGINS, J. T. SALDIVAR, P. J. LYNE, and G. E. FUNKHOUSER Mar. 1987 75 p
(AD-A181089; DOT/FAA/AM-87/2) Avail: NTIS HC A04/MF A01 CSCL 06N

This study was undertaken to evaluate workloads, oxygen consumption, carbon dioxide production and respiratory exchange rates for passengers during an emergency aircraft evacuation. This was accomplished in an effort to formulate possible qualification standards for a passenger protective breathing device intended to protect from smoke and fumes. GRA

N87-27384# Stanford Univ., Calif. Dept. of Psychology.
PROPERTIES AND CONSEQUENCES OF VISUAL PERSISTENCE Final Report, 1 Sep. 1984 - 30 Jun. 1986

MICHAEL PAVEL 18 Feb. 1987 12 p
(Contract AF-AFOSR-0308-84)
(AD-A181139; AFOSR-87-0713TR) Avail: NTIS HC A02/MF A01 CSCL 05H

The major effort in our laboratory was directed to investigating the ability of subjects to represent and use visual spatial location. One series of experiments was concerned with the effects of expectation of events (stimuli) at different spatial locations, on the performance of observers in different type of tasks. The results indicate that attentional effects (change in sensitivity) depend on the attentional instructions as well as on the complexity of the tasks. Another series of studies was carried out to assess the accuracy of perceived relative location as a function of visual yield eccentricity. The goal was to determine to what extent can human pattern recognition abilities be characterized as a translation invariant (after appropriate scaling) system. The results indicate that, although translation invariance does not hold, there are regularities in the data that give rise to interesting models of visual representation of distances. Another series of experiments was carried out to determine how people judge the direction of motion and how accurately they predict the final location of a moving target. The somewhat surprising results indicate that the judgement of moving targets yield similar accuracy as those with static stimuli. GRA

N87-27385# Army Aeromedical Research Lab., Fort Rucker, Ala.

LOW ALTITUDE, HIGH SPEED PERSONNEL PARACHUTING: MEDICAL AND PHYSIOLOGICAL ISSUES Final Report

DAVID J. WEHRLY Feb. 1987 26 p
(AD-A181199; USAARL-87-3) Avail: NTIS HC A03/MF A01 CSCL 06J

This report reviews the medical and physiological issues in high speed, low altitude parachuting. Accident and experimental data are reviewed. The dearth of experimental/operational data related to these issues is noted. GRA

N87-27386# Rochester Univ., N. Y. Center for Visual Science.
COMPUTATIONAL MODELS IN HUMAN VISION SYMPOSIUM (15TH) HELD ON JUNE 19-21, 1986 IN ROCHESTER, NEW YORK Final Report, 1 Feb. - 31 Mar. 1987

MARY M. HAYHOE and JEROME FELDMAN 31 Mar. 1987
168 p Symposium held in Rochester, N.Y., 19-21 Jun. 1986
(Contract AF-AFOSR-0118-86)
(AD-A181270; AFOSR-87-0607TR) Avail: NTIS HC A08/MF A01 CSCL 06D

This is a collection of abstracts and papers from a symposium on Computational Models in Human Vision held at the Center for Visual Science in June of 1986. Recently, a number of significant contributions to understanding human vision have come from the field of Artificial Intelligence. This influence is changing the scope and nature of the study of vision. The aim of the symposium was to crystallize this trend for the community of visual scientists, to review its contribution to the study of human vision, and to promote communication between vision scientists in neurophysiology, psychophysics, perception and computer vision. Papers were presented on: motion, color, texture, shape and form, space, and contextual effects and attention. These are all areas in which there has been significant computational work, and the abstracts in this collection reflect the current state of the field. GRA

N87-27387# Boston Univ., Mass. Center for Adaptive Systems.
PERCEPTUAL DYNAMICS, REAL-TIME IMAGE PROCESSING, AND NEURAL ARCHITECTURES Final Report, 1 Feb. 1985 - 31 Jan. 1987

STEPHAN GROSSBERG 20 May 1987 32 p
(Contract AF-AFOSR-0149-85)
(AD-A181295; AFOSR-87-0724TR) Avail: NTIS HC A03/MF A01 CSCL 06K

Annotated bibliography of research articles published during this project pertaining to a neural architecture for pattern recognition (Adaptive Resonance Theory); a model of pre-attentive vision (the boundary + feature contour systems); application of art to speech recognition; and models of attentional control of low-level sensory representations. GRA

N87-27388# Michigan Univ., Ann Arbor. Dept. of Physiology.
CIRCADIAN VARIATION IN HOST DEFENSE Final Report, Nov. 1984 - Mar. 1987

MATTHEW J. KLUGER 21 May 1987 5 p
(Contract N00014-85-K-0027; PROJ. RR0-4108)
(AD-A181319) Avail: NTIS HC A02/MF A01 CSCL 06D

The circadian rhythm in body temperature is thought to be due to a rhythm in the thermoregulatory set-point. The overall goal of our research was to determine whether this represents a circadian fever. If this hypothesis is correct, then antipyretic drugs should attenuate the rhythm in body temperature. We have found that administration of a variety of antipyretic drugs to rats markedly reduced their nighttime elevation in body temperature. These data suggest to us that prostaglandins are probably involved in the circadian rhythm in body temperature. We have attempted to determine whether this rhythm in prostaglandins is dependent on a rhythm in circulating concentrations of interleukin-1 (IL-1). Based on studies with rats and human beings using bioassays and immunoassays, we have been unable to detect any rhythm in plasma concentration of IL-1. We conclude that it is unlikely that circulating IL-1 has a role in the rhythm in body temperature. If IL-1 influences the circadian rhythm in body temperature, it may do so at the level of the hypothalamus or at some other central nervous site. GRA

N87-27389# Illinois Univ., Urbana-Champaign. Inst. of Aviation.
THE EFFECTS ON PILOT PERFORMANCE OF ANTIEMETIC DRUGS ADMINISTERED SINGLY AND IN COMBINATION Final Report, Feb. 1983 - May 1985

HENRY L. TAYLOR, JOHN A. DELLINGER, MARTHA H. WELLER, BRUCE C. RICHARDSON, and FRED C. HYMAN Mar. 1987 12 p
 (Contract F33615-83-K-0612)
 (AD-A181549; USAFSAM-TR-85-99) Avail: NTIS HC A02/MF A01 CSCL 06O

Four experiments were conducted to evaluate the effects on human performance of alcohol and antiemetic drugs. In Experiment 1, the effects on pilot performance of 4 blood alcohol levels (BAL) were investigated to determine the sensitivity of the methodology. Experiment 2 evaluated the effects on pilot performance in a flight simulator of prescribed dosages of thiethylperazine (10 mg), promethazine hydrochloride (25 mg), cimetidine (300 mg), and a placebo control. Two tasks, a two-dimensional tracking task which is part of an instrument landing system (ILS) approach and the Sternberg Memory Search task, were used to generate pilot performance data. In Experiment 3 the effects of combinations of antiemetic drugs were investigated. Two additional flight task dependent variables, turning rate control while straight and level and while turning were added. Experiment 4 evaluated the effects of alcohol on pilot performance; the results were compared with the performance degradations resulting from combinations of antiemetic drugs. The results indicated that 0.12 percent BAL produced a decrement in pilot simulator instrument flight performance. In comparison with the PTC effects, the high BAL produced a relatively larger performance decrement than the PTC combination. GRA

N87-27390# Los Alamos National Lab., N. Mex.

A LAYERED NETWORK MODEL OF SENSORY CORTEX
 B. J. TRAVIS 1986 50 p Presented at the 3rd International Conference on Computer Simulations in Brain Science, Copenhagen, Denmark, 1 Aug. 1986
 (Contract W-7405-ENG-36)
 (DE87-008998; LA-UR-87-1275; CONF-8608178-1) Avail: NTIS HC A03/MF A01

An integrated computational approach to modeling sensory systems which couples realistic layered neural models of sensory cortex and midbrain nuclei to detailed models of the sense organs (e.g., retina or cochlea) is described. The approach is applied to the auditory system. Through an exercise of the model, it is shown that spatial location of sounds may be a natural consequence of the way cochlear response is mapped onto the cortex. DOE

N87-27391# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).

AGARD GUIDE TO AEROSPACE AND DEFENCE TECHNICAL REPORT SERIES IN NATO COUNTRIES
 May 1987 348 p
 (AGARD-R-743; ISBN-92-835-1549-8) Avail: NTIS HC A15/MF A01

A guide is presented to technical reports series relating to aerospace and defence research and development currently published by governments, contractors, research laboratories or universities in NATO member countries. The guide lists reports series from Belgium, France, the Federal Republic of Germany, the Netherlands, Norway, the United Kingdom, the United States and international organizations. Information given includes a technical report series code, a title (where available), name and address of the organization producing the series, availability (where known), type of organization and other helpful information provided by the producers. Two indexes are provided: an overall one by number; and one by number within country Author

N87-27392*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

QUALITY REQUIREMENTS FOR RECLAIMED/RECYCLED WATER

DANIEL S. JANIK (National Academy of Sciences - National Research Council, Houston, Tex.), RICHARD L. SAUER, DUANE L. PIERSON, and YVONNE R. THORSTENSON Mar. 1987 35 p
 (NASA-TM-58279; S-559; NAS 1.15:58279) Avail: NTIS HC A03/MF A01 CSCL 06K

Water used during current and previous space missions has been either carried or made aloft. Future human space endeavors will require some form of water reclamation and recycling. There is little experience in the U.S. space program with this technology. Water reclamation and recycling constitute engineering challenges of the broadest nature that will require an intensive research and development effort if this technology is to mature in time for practical use on the proposed U.S. Space Station. In order for this to happen, reclaimed/recycled water specifications will need to be devised to guide engineering development. Present NASA Potable Water Specifications are not applicable to reclaimed or recycled water. Adequate specifications for ensuring the quality of the reclaimed or recycled potable water system is reviewed, limitations of present water specifications are examined, world experience with potable water reclamation/recycling systems and systems analogs is reviewed, and an approach to developing pertinent biomedical water specifications for spacecraft is presented. Space Station water specifications should be designed to ensure the health of all likely spacecraft inhabitants including man, animals, and plants. Author

N87-27393*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE EFFECT OF EXERCISE ON VENOUS GAS EMBOLI AND DECOMPRESSION SICKNESS IN HUMAN SUBJECTS AT 4.3 PSIA

JOHNNY CONKIN, JAMES M. WALIGORA, DAVID J. HERRIGAN, JR., and ARTHUR T. HADLEY, III Mar. 1987 21 p
 (Contract NAS9-17200)
 (NASA-TM-58278; S-558; NAS 1.15:58278) Avail: NTIS HC A02/MF A01 CSCL 06P

The contribution of upper body exercise to altitude decompression sickness while at 4.3 psia after 3.5 or 4.0 hours of 100% oxygen prebreathing at 14.7 psia was determined by comparing the incidence and patterns of venous gas emboli (VGE), and the incidence of Type 1 decompression sickness (DCS) in 43 exercising male subjects and 9 less active male Doppler Technicians (DT's). Each subject exercised for 4 minutes at each of 3 exercise stations while at 4.3 psia. An additional 4 minutes were spent monitoring for VGE by the DT while the subject was supine on an examination cot. In the combined 3.5 and 4.0 hour oxygen prebreath data, 13 subjects complained of Type 1 DCS compared to 9 complaints from DT's. VGE were detected in 28 subjects compared to 14 detections from DT's. A chi-square analysis of proportions showed no statistically significant difference in the incidence of Type 1 DCS or VGE between the two groups; however, the average time to detect VGE and to report Type 1 DCS symptoms were statistically different. It was concluded that 4 to 6 hours of upper body exercise at metabolic rates simulating EVA metabolic rates hastens the initial detection of VGE and the time to report Type 1 DCS symptoms as compared to DT's. Author

N87-27394# Nancy Univ. (France).

THE SPACE ADAPTATION SYNDROME Ph.D. Thesis [LE SYNDROME D'ADAPTATION A L'ESPACE]

VERONIQUE DIDIER 1987 119 p In FRENCH
 (ETN-87-90120) Avail: NTIS HC A06/MF A01

The space syndrome, the physiological effects of spacecraft life on the human body, and aspects of weightless environments are discussed. The inner ear equilibrium is analyzed. Treatment and prevention practices are described. It is concluded that it is a

minor factor in the space adventure, not really dangerous, but a major handicap for manned space flight. ESA

N87-28244# Vistech Consultants, Inc., Dayton, Ohio.
SUPRATHRESHOLD CONTRAST SENSITIVITY VISION TEST CHART Final Report
 ARTHUR GINSBURG 28 Apr. 1987 35 p
 (Contract F49620-86-C-0116)
 (AD-A181733; AFOSR-87-0711TR) Avail: NTIS HC A03/MF A01 CSDL 06D

Although visual acuity has been the main measure of visual capability for over 125 years for both the military and civilians, it has been shown not to relate well to visual performance. A new measure of visual capability, contrast sensitivity, has been shown to relate to individual differences in visual capability such as target detection in the laboratory, in flight simulators, and in field studies. Contrast sensitivity testing with sine-wave gratings provides a very accurate measure of target detection threshold. However, although threshold measurements are very important in evaluating pilot visual performance, there are many other critical visual tasks performed at suprathreshold contrast levels. Routine measurement of suprathreshold contrast sensitivity has been difficult to accomplish until now, however, due to the expensive, time-consuming, and complex computer-video systems required for testing. To answer this need, Vistech Consultants, Inc. proposed to develop a new suprathreshold contrast sensitivity vision test chart. This chart was to be designed to measure individual differences related to visual performance. The psychophysical procedure of contrast matching was used to measure an individual's suprathreshold contrast perception of sine-wave gratings for appropriate ranges of spatial frequency and contrast. GRA

N87-28245# Arctic Inst. of North America, Arlington, Va.
OPERATION EVEREST 2: EFFECTS OF A SIMULATED ASCENT TO 29,000 FEET ON NUTRITION AND BODY COMPOSITION Final Report, Sep. - Nov. 1985
 MADELEINE S. ROSE, CHARLES S. HOUSTON, CHARLES S. FULCO, GEOFFREY COATES, and DAWN CARLSON 29 May 1987 129 p
 (Contract DAMD17-85-C-5306; DA PROJ. 3M2-63763-D-819)
 (AD-A181855; USARIEM-T-15-87) Avail: NTIS HC A07/MF A01 CSDL 06D

Progressive body weight loss occurs during high mountain expeditions, but whether it is due to hypoxia, inadequate diet, malabsorption, or to the multiple stresses of the harsh environment is unknown. To determine whether hypoxia alone causes such body weight loss, six men were studied during progressive decompression to 240 torr for 40 days in a hypobaric chamber where hypoxia was the major variable. The subjects were provided a palatable ad libitum diet that was modified for individual preferences. Complete food consumption data were available for only 38 of the 40 days. Mean caloric intake for 38 days at altitude was 2639 + or - 848 kcal/day (Mean + or - SD). Caloric intake decreased 42.3% from 3136 kcal during the first 7 days of exposure to altitude to 1789 kcal during the last 3 days at 282 to 240 Torr. During the same time periods the carbohydrate (CHO) intake decreased from 62.1% to 53.2% (p less than 0.001). All subjects lost body weight with a mean loss of 7.44 + or - 2.24 kg (8.90% of the initial body weight). Loss of body weight was greater than could be accounted for by comparing calculated energy expenditures to actual caloric intake. GRA

N87-28246# National Aerospace Medical Centre, Soesterberg (Netherlands).
REPORT OF THE FIRST REGIONAL CIVIL AVIATION MEDICINE SEMINAR
 1985 72 p Seminar held in Zeist, The Netherlands, 18-23 Nov. 1985
 (ETN-87-90152) Avail: NTIS HC A04/MF A01

The aircraft designer's idea about the flight crew; clinical methods in preventive medicine; developments in antihypertensive therapy in pilots; the value of electrocardiogram examination; cardiac arrhythmia in symptomatic and asymptomatic populations

(implications for licensing and follow-up of pilots and air traffic controllers) developments in civil aviation and in ophthalmology, cockpit ergonomics and psychological aspects in aviation; psychosocial stress in commercial aircraft pilots; and aircraft accident analysis were discussed. ESA

N87-28247*# University of Southern Illinois, Carbondale. Dept. of Physiology.
CHARACTERIZATION OF NEUROSPORA CIRCADIAN RHYTHMS IN SPACE Final Technical Report
 JAMES S. FERRARO 10 Sep. 1987 14 p
 (Contract NAG2-361)
 (NASA-CR-181284; NAS 1.26:181284) Avail: NTIS HC A02/MF A01 CSDL 06P

To determine whether the circadian rhythm of conidiation in *neurospora crassa* is endogenously derived or is driven by some geophysical time cue, an experiment was conducted on space shuttle flight STS-9, where inoculated race tubes were exposed to the microgravity environment of space. The results demonstrated that the rhythm can persist in space. However, there were several minor alterations noted; an increase in the period of the oscillation and the variability of the growth rate and a diminished rhythm amplitude, which eventually damped out in 25% of the flight tubes. On day seven of the flight, the tubes were exposed to light while their growth fronts were marked. It appears that some aspects of this marking process reinstated a robust rhythm in all the tubes which continued throughout the remainder of the flight. It was hypothesized that the damping found prior to the marking procedure on STS-9 may have been a result of the hypergravity pulse of launch and not due to the microgravity of the orbital lab; furthermore, that the marking procedure, by exposing the samples to light, had reinstated rhythmicity. To test this, an investigation was conducted into the effects of acute and chronic exposure to hypergravity. Author

N87-28248* National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES (SUPPLEMENT 301)
 Sep. 1987 77 p
 (NASA-SP-7011(301); NAS 1.21:7011(301)) Avail: NTIS HC A05 CSDL 06E

This bibliography lists 217 reports, articles, and other documents introduced into the NASA scientific and technical information system in August, 1987. Author

N87-28249# Naval Health Research Center, San Diego, Calif.
THE EFFECT OF SLEEP DEPRIVATION AND MODERATE INTERMITTENT EXERCISE ON MAXIMAL AEROBIC CAPACITY Interim Report
 JOHN E. YEAGER, RONALD P. CRISMAN, and ANTHONY A. SUCEC 15 Jan. 1987 16 p
 (AD-A181934; NHRC-86-36) Avail: NTIS HC A02/MF A01 CSDL 06D

The purpose of this study was to determine the effects of moderate intermittent work (IW), partial sleep deprivation (PSD) and 8 hrs of recovery sleep (RS) on maximal oxygen uptake (VO₂max). The IW consisted of two 20 hr periods separated by a 3 hr nap. Thirty male subjects with the following mean characteristics (age = 21.2 yrs, height = 176.6 cm, and weight = 74.9 kg) were randomly assigned to a non-exercising group (C), or an exercising group (E). Subjects were further randomly assigned to Noon (N) or Midnight (M) start times. Comparisons of low (L) and high (H) fitness levels based on baseline VO₂max were also made. All groups underwent PSD with E walking on a treadmill at 30% of VO₂max for 30 mins/hr VO₂max, maximum heart rate (HRmax) and maximal treadmill walk times (WT) were measured three times; baseline (T1), after IW (T2) and after RS (T3). The L and H means for VO₂max were 45.7 and 54.3 ml/kg/min, respectively, while all other group means were within 2 ml/kg/min of 50 ml/kg/min, STPD. Following PSD VO₂max dropped 3.5% in C and increased 2.5% in E (P 0.05). The HRmax means were within 5 bts/min of 197/min for all groups, and the

means WT_s were between 12.0 and 12.8 mins with only the H and M groups demonstrating with means of 13.4 and 13.3 mins, respectively. The changes in C and E following PSD support the hypothesis that moderate IW counteracts PSD C and E following PSD induced decrements in VO₂max. Neither fitness level nor start time altered the effect of PSD on VO₂max. GRA

N87-28250# Naval Health Research Center, San Diego, Calif.
L-TRYPTOPHAN, SLEEP, AND PERFORMANCE Interim Report
 CHERYL L. SPINWEBER 10 Mar. 1987 25 p
 (AD-A181941; NHRC-87-4) Avail: NTIS HC A02/MF A01
 CSCL 06O

Planning for adequate rest and predicting the consequences of inadequate sleep or cumulative sleep loss should be an important consideration in mission logistics. The use of a sleeping aid may be appropriate to permit personnel to maximize sleep effectiveness in operational environments. At NHRC, we have investigated the amino acid l-tryptophan as a non sedating sleeping aid for military use. Attention focused on l-tryptophan because of its role as the dietary precursor of serotonin. The neurotransmitter first identified by Jouvet as involved in the regulation of sleep. Recent reviews continue to debate the effectiveness of l-tryptophan as a sleeping aid and the underlying mechanism for its effects. GRA

N87-28251# Naval Health Research Center, San Diego, Calif.
PERCEIVED EXERTION UNDER CONDITIONS OF SUSTAINED WORK AND SLEEP LOSS Interim Report
 DAVID H. RYMAN, P. NAITOH, and C. E. ENGLUND 25 Mar. 1987 22 p
 (AD-A182148; AD-E900674; NHRC-87-9) Avail: NTIS HC A02/MF A01 CSCL 06J

The relationships of perceived exertion (RPE) to workload, heart rate, and psychological measures during repeated treadmill walking while carrying 22kg have been analyzed in 2 studies. Exercising subjects alternated 30 min walks with 30 min of tasks for 16 one hr sessions on each of 2 consecutive days. Study 1 used an initial treadmill grade and speed producing 40% maximum oxygen consumption (VO₂ max). This level was maintained until a subject could no longer complete a 30 min exercise session. Subsequently treadmill grade and then speed were reduced to a maintainable rate. Subjects got a 4 hr nap (Group 1) or rest (Group 2) between days. Study 2 used 30% VO₂ max throughout and a 3 hr nap between days. One group started at midnight, the other at noon. Both studies showed a linear increase in RPE during each day ($p < .05$) and a drop in RPE from the end of Day 1 to the start of Day 2 ($p < .001$). Napping rather than just resting or starting at midnight rather than at noon did not change RPE. RPE was higher Day 2 than Day 1 in Study 2 ($p < .05$). RPE increased through the stages of the maximal treadmill tests but did not vary among the 3 tests in Study 2. RPE was significantly correlated with heart rate, speed, and elevation gained (r and/or p) during most of Day 1 in Study 1 but not in Study 2. Psychological measures showed correlations with RPE only during the third 4 hr period of Day 1 in Study 1 for fatigue, vigor and sleepiness while these relationships persisted through most of day 1 in study 2. GRA

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BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

A87-47319* Illinois Univ., Champaign.
A PSYCHOPHYSIOLOGICAL ASSESSMENT OF OPERATOR WORKLOAD DURING SIMULATED FLIGHT MISSIONS
 ARTHUR F. KRAMER, ERIK J. SIREVAAG, and ROLF BRAUNE (Illinois, University, Champaign) Human Factors (ISSN 0018-7208), vol. 29, April 1987, p. 145-160. NASA-supported research. refs (Contract F49620-83-C-0144)

The applicability of the dual-task event-related (brain) potential (ERP) paradigm to the assessment of an operator's mental workload and residual capacity in a complex situation of a flight mission was demonstrated using ERP measurements and subjective workload ratings of student pilots flying a fixed-based single-engine simulator. Data were collected during two separate 45-min flights differing in difficulty; flight demands were examined by dividing each flight into four segments: takeoff, straight and level flight, holding patterns, and landings. The P300 ERP component in particular was found to discriminate among the levels of task difficulty in a systematic manner, decreasing in amplitude with an increase in task demands. The P300 amplitude is shown to be negatively correlated with deviations from command headings across the four flight segments. I.S.

A87-47320* Toronto Univ. (Ontario).
SPECTRAL ANALYSIS OF SINUS ARRHYTHMIA - A MEASURE OF MENTAL EFFORT
 KIM J. VICENTE, D. CRAIG THORNTON, and NEVILLE MORAY (Toronto, University, Canada) Human Factors (ISSN 0018-7208), vol. 29, April 1987, p. 171-182. refs (Contract NAGW-429)

The validity of the spectral analysis of sinus arrhythmia as a measure of mental effort was investigated using a computer simulation of a hovercraft piloted along a river as the experimental task. Strong correlation was observed between the subjective effort-ratings and the heart-rate variability (HRV) power spectrum between 0.06 and 0.14 Hz. Significant correlations were observed not only between subjects but, more importantly, within subjects as well, indicating that the spectral analysis of HRV is an accurate measure of the amount of effort being invested by a subject. Results also indicate that the intensity of effort invested by subjects cannot be inferred from the objective ratings of task difficulty or from performance. I.S.

A87-47321
THE SPATIAL ALLOCATION OF VISUAL ATTENTION AS INDEXED BY EVENT-RELATED BRAIN POTENTIALS
 G. R. R. MANGUN and S. A. HILLYARD (California, University, La Jolla) Human Factors (ISSN 0018-7208), vol. 29, April 1987, p. 195-211. refs (Contract NIH-MH-25594; N00014-86-K-0291)

The spatial distributions of visual attention was studied using event-related brain potentials (ERPs) to index stimulus processing as the locus of attention was shifted across the visual fields. Stimuli were flashed in random order to one of three locations: one in each of the lateral visual fields and one on the vertical meridian. Selective visual-spatial attention was manifested in the ERPs as an amplitude modulation of the sensory-evoked components over frontal, central, parietal, and occipital scalp areas. Attended stimuli also elicited broader negative components that appeared to be endogenous and could be dissociated from the amplitude enhancement of the earlier sensory-evoked components. A gradient of attention was evident in the progressive decline in amplitude of the sensory-evoked components of the ERPs to the lateral stimuli as attention was focused at increasing distances from the stimulus location. These results are discussed in terms

of 'spotlight' and 'gradient' models of the spatial allocation of visual attention. Author

A87-47322

EFFECTS OF INFORMATION-PROCESSING DEMANDS ON PHYSIOLOGICAL RESPONSE PATTERNS

LANCE O. BAUER, ROBERT GOLDSTEIN, and JOHN A. STERN (Washington University, Saint Louis, MO) Human Factors (ISSN 0018-7208), vol. 29, April 1987, p. 213-234. refs (Contract F49620-83-C-0059)

The effects of increased attention and encoding/rehearsal demands on EEG, ECG, and electrooculogram parameters were studied in subjects subjected to varying memory sets and test stimuli. Encoding/rehearsal demands were varied by manipulating the number of letters comprising a briefly presented memory set that the subject was instructed to encode, retain, and, 5 sec later, to compare with a single test-letter. Attention demands were varied by presenting the subject with a cue stimulus (the numeral 1, 3, or 5), 5 sec prior to the presentation of the letter set, informing the subject of the number of letters contained therein. It was found that, in the interval preceding the memory set, where the attention demands were varied, the probe ERP P1-N1 amplitude increased with the size, while in the subsequent interval, where the encoding and rehearsal demands were varied, the probe ERP N1-P2 amplitude declined with increasing set size. Interval and set-size effects on heart rate, eye-blink rate, and task ERPs were also observed. I.S.

A87-47501

LABORATORY INVESTIGATION OF THE PSYCHOLOGICAL FEATURES OF THE CONTROL OF MOVING OBJECTS [LABORATORNOE IZUCHENIE PSIKHOLOGICHESKIKH OSOBENNSTEI UPRAVLENIIA PODVIZHNYMI OB'EKTAMI]

E. V. ZHORNIK Problemy Bioniki (ISSN 0555-2656), no. 36, 1986, p. 44-48. In Russian.

An experimental procedure for the remote control of the velocity of moving objects (e.g., robots, aircraft, spacecraft, etc.) is proposed which assesses the psychological characteristics of the operators. Particular attention is given to the task of braking a moving object until it comes to a full stop at a specified point. It is shown that the decision-making strategy of the operator changes in the course of the braking process. When passing from high to low velocities, the operator switches from velocity control to control according to graded time intervals of braking. B.J.

A87-47725

REACTION TIME AND EYE TRACKING VELOCITY

A. J. GOUREVICH, G. D. DIMITROV, and L. I. MITRANI (B'lgarska Akademiia na Naukite, Institut po Fiziologija, Sofia, Bulgaria) Bolgarskaia Akademiia Nauk, Doklady (ISSN 0366-8681), vol. 40, no. 3, 1987, p. 101-103. refs

Reaction times (RT) at different smooth eye tracking velocities are studied. In the first experiment, the stimulus was the abrupt disappearance of a light spot moving at 1, 3.6, 7, and 14 deg/sec. In the second experiment, it was the disappearance of a spot fixed in the center of the visual field; in both cases, the subjects had to press a button as quickly as possible after the spot's disappearance. It was found that an increase in the spot's velocity led to a decrease in RT. The RT to the immobile stimulus was significantly lower than the corresponding RT at low velocities. K.K.

A87-49167#

THE RESPONSE OF AIRLINE PILOTS TO FLIGHT SIMULATOR MOTION

LLOYD D. REID and MEYER A. NAHON (Toronto, University, Canada) IN: AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1987, p. 77-85. NSERC-supported research. refs (Contract CDC-OSD83-00101; CDC PROJECT 6069) (AIAA PAPER 87-2436)

The use of physical motion in flight simulation is still a much debated topic. This paper investigates the more narrow issue of its application in commercial jet transport simulators. An attempt was made to quantify the perceptions of airline pilots about the quality of motion possible when a number of different motion-drive algorithms are tested on a simulator employing a state-of-the-art six degrees-of-freedom motion-base. Four broad categories of algorithm were tested: classical washout, optimal control, coordinated adaptive, and no-motion. It was found that although there was little impact of algorithm type on performance and control activity, there was a definite effect on how the pilots perceived the simulation environment. Based on these findings it appears that the coordinated adaptive algorithm is generally preferred by the pilots over the other algorithms tested. There was almost unanimous dislike of the no-motion case. Author

A87-49450

PARALLEL AND SERIAL PROCESSES IN MOTION DETECTION

MIRI DICK, SHIMON ULLMAN, and DOV SAGI (Weizmann Institute of Science, Rehovot, Israel) Science (ISSN 0036-8075), vol. 237, July 24, 1987, p. 400-402. refs

Apparent motion was used to explore human ability to perceive the direction of motion in the visual field. A marked qualitative difference in this ability was found between short- and long-range motion. For short-range motion, the detection of the direction of motion is characterized by parallel operation over a wide visual field (that is, detection performance is independent of the number of objects in an array). When the positional displacement is large relative to an object's size, the direction of motion is detected in a serial manner. The process of detection is limited in this case by the ability to detect other events, such as appearance and disappearance of an object, and the ability to compute their spatio-temporal relations. The results are consistent with a previously suggested division of the motion detection system into short- and long-range processes. The direction of short-range motion can be perceived in parallel (preattentively), whereas long-range motion is attentive and requires more complicated computations. It seems that the detection of long-range motion is a conjunction task, combining the detection of disappearance and appearance. Author

A87-49580*# Purdue Univ., West Lafayette, Ind.

MODEL-BASED ANALYSIS OF CONTROL/DISPLAY INTERACTION IN THE HOVER TASK

DAVID K. SCHMIDT (Purdue University, West Lafayette, IN) and SANJAY GARG IN: AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1987, p. 23-31. refs (Contract NAG4-1) (AIAA PAPER 87-2287)

The effect of Control/Display interaction in the hover task is analyzed using an optimal control approach to modeling pilot control behavior. The control/display configurations considered are those previously evaluated in a flight research program. The experimental data-base is reviewed and the procedure for modeling the task and the displayed information is presented in detail. All model-based results, time-domain as well as frequency-domain, are found to correlate extremely well with the subjective pilot ratings and comments. Time-domain measures consist of root mean-square errors and control inputs, attention allocation to displayed quantities, and magnitudes of task objective function.

Frequency-domain measures include bandwidth, stability margins, and pilot phase compensation. Results are also shown to agree with previous findings on task interference in multi-axis tasks.

Author

A87-50311

RETROSPECTIVE COHORT ANALYSIS OF CLASS A MISHAPS IN AVIATORS EVALUATED AT USAFSAM - 1957-1984

DAVID K. MCKENAS and WILLIAM G. JACKSON (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 735-741. refs

A retrospective analysis of Class A mishaps in all United States Air Force (USAF), Air National Guard (ANG), and Air Force Reserve (AFR) pilots ($n = 5088$) evaluated at the USAF School of Aerospace Medicine (USAFSAM) from 1957 to 1984 was conducted to test whether the cohort career mishap experience differed significantly from the general USAF, AFR, and ANG pilot population. The analysis involved merging the USAFSAM Cover Sheet computer file with the Aircraft Accident Data System and Flight Record Data System. A life table analysis compared observed cohort mishap accumulation over career flight hours with theoretical curves derived from USAF wide aircraft year-specific Class A mishap rates. The cohort experienced significantly fewer (p less than 0.005) mishaps over career flight hours in all major aircraft categories except trainers, in which the cohort experienced significantly more mishaps ($p = 0.013$).

Author

A87-50318

CIGARETTE SMOKING, FIELD-DEPENDENCE AND CONTRAST SENSITIVITY

BERNARD J. FINE and JOHN L. KOBRICK (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 777-782. refs

This study examined the separate and combined effects of cigarette smoking and field-dependence on contrast sensitivity. No previous research on these relationships exists; however, all three variables are known to be significantly related to many aspects of human performance. Under carefully controlled conditions, 12 smokers and 16 nonsmokers were tested for field-dependence and measured for contrast sensitivity (Nicolet CS 2000 Testing System). No differences in contrast sensitivity of smokers were found when measured immediately after smoking one cigarette, as compared with having been deprived of smoking for at least 90 min. Habitual smoking and field-dependence were found to be separately and interactively related to contrast sensitivity. A field-independent nonsmoker group performed significantly better than a field-dependent smoker group at all but the lowest spatial frequency. The results have important implications for many types of performance, particularly aircraft and motor vehicle operation, and may be valuable for use in selection and training.

Author

A87-50319

INTENSITY JUDGMENTS OF VIBRATIONS IN THE Y AXIS, Z AXIS, AND Y-PLUS-Z AXES

RICHARD W. SHOENBERGER (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 783-787. refs

(Contract F33615-82-C-0504)

Seated subjects matched their perceptions of the intensity of Y-axis, Z-axis, or Y-plus-Z vibrations by adjusting the intensity of a sinusoidal 5-Hz X-axis response vibration. Stimuli were sinusoidal at 3.2, 5, and 8 Hz. For each frequency there were six vibration conditions (Y axis alone, Z axis alone, or both axes together with 0, 90, 180, or 270 deg phase angles between them) presented at each of two acceleration levels (0.15 and 0.25 G rms). Results showed that X-axis response accelerations for the dual-axis stimuli were greater than those for either one of their Y-axis or Z-axis components. This occurred for both acceleration levels and for all three frequencies. In addition, response acceleration was nearly

constant for the dual-axis stimuli regardless of the phase angle between their Y-axis and Z-axis components. Again, this was true for both acceleration levels and all three frequencies. These findings indicate that, although dual-axis vibrations are judged to have greater subjective intensity than either of their single-axis components, the phase relationship between those components appears to have no appreciable effect.

Author

A87-50322

GRIEF IN THE GROUNDED AVIATOR

DONALD S. GEEZE (USAF, School of Aerospace Medicine, Brooks AFB, TX) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 799-801. refs

Grounding aviators is an important and difficult aspect of being a flight surgeon. The psychological impact that grounding has on a flier may not only represent a serious pathological process in itself, but may also detrimentally affect the flight surgeon's relationships with other crewmembers. Grounding represents a loss to the aviator, the severity of which varies with pre-morbid motivation to fly. As a loss, grounding elicits grief; this must be dealt with effectively by the patient, with the help of the flight surgeon, or an unresolved grief reaction may cripple the ex-flier and hinder the flight surgeon's effectiveness.

Author

A87-50539#

PILOT-VEHICLE ANALYSIS OF MULTI-AXIS TASKS

DUANE MCRUER (Systems Technology, Inc., Hawthorne, CA) and DAVID K. SCHMIDT (Purdue University, West Lafayette, IN) IN: AIAA Guidance, Navigation and Control Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. Volume 2. New York, American Institute of Aeronautics and Astronautics, 1987, p. 1312-1323. refs
(Contract F33615-85-C-3610)
(AIAA PAPER 87-2538)

In missions where high cognitive and managerial requirements are placed on the pilot, or where failures may significantly degrade one or more aircraft control axes, the pilot must divide his attention among several tasks. The pilot and system behavior in such divided attention conditions, and the combination of pilot ratings from single to multi-axis conditions are treated using classical and optimal control models for the human in a complementary fashion. It is shown that the crossover frequency and closed-loop system performance for a given axis under divided attention will be less than full attention values while the remnant and the phase margin will be greater, and that the model-based trends are consistent with experiment. Also, the optimal control performance index used in the pilot and system behavioral modeling, when 'calibrated' with single-axis correlations, shows potential for the development of subjective rating estimates for multi-axis tasks.

Author

N87-27395#

A COMPARISON OF TRACKING PERFORMANCE DURING GY STRESS BETWEEN TEST PILOTS AND PANEL SUBJECTS

Technical Report, Jul. 1981 - Aug. 1982
JOHN W. FRAZIER, DANIEL W. REPPERGER, ROBERT E. VANPATTEN, and CHARLES D. GOODYEAR Mar. 1987 19 p
(Contract F33615-81-C-0500; F33615-83-C-0502)
(AD-A181080; AAMRL-TR-87-018) Avail: NTIS HC A02/MF A01 CSDL 01B

Seven centrifuge subjects and three AFT1/F-16 test pilots have participated in performance measuring experiments conducted on the Dynamic Environment Simulator (DES), a man-rated centrifuge. The primary task was a computer generated roll axis pursuit tracking task. The secondary task was to maintain the status quo of airspeed, altitude, pitch, and yaw. Test conditions included plus and minus 1.0, 1.25, 1.5, 1.75, and 2.0 Gy both with a standard restraint harness and with additional lateral support provided by shoulder pads. For all Gy conditions the secondary task was 9% better. These differences were not statistically significant. Both groups performed better when the shoulder pads (improved restraint system) were used. The standard restraint harness was rated inadequate at levels greater than 1.5 Gy.

GRA

N87-27396# Pennsylvania Univ., Philadelphia.
DIRECT ACCESS BY SPATIAL POSITION IN VISUAL MEMORY. PART 2: VISUAL LOCATION PROBES Technical Report, 1 Sep. 1985 - 31 Aug. 1987
 SAUL STERNBERG, RONALD L. KNOLL, and DAVID L. TUROCK 31 Dec. 1986 96 p
 (Contract N00014-85-K-0643; DA PROJ. RR0-4204; DA PROJ. RR0-4206)
 (AD-A181493; TR-3) Avail: NTIS MF A01 CSCL 05H

This report continues our series on the short-term dynamics of human visual memory. We summarize the history of the problem, discuss some properties that define a representation as being visual, outline a new approach embodied in four experimental procedures, consider some general issues of design and analysis in assessing an array-size effect, and report on findings from a set of experiments using the spatial-probe procedure with a visual marker as probe. The principal phenomenon is an effect of array size (3 to 6 digit elements) on the time to name a visually marked element in a brief visual display that increases rapidly with marker delay, revealing a transformation of the internal representation of the array that is completed within a second. For early markers the effect of array size is negligible, indicating a property of direct access by spatial location. For late markers the effect of array size on mean reaction time is a linear increase. GRA

N87-27397*# Texas Univ., Austin. Dept. of Psychology.
THE CRITICAL ROLE OF PERSONALITY AND ORGANIZATIONAL FACTORS AS DETERMINANTS OF REACTIONS TO RESTRICTED AND STRESSFUL ENVIRONMENTS
 ROBERT L. HELMREICH 1987 16 p Presented at the 3rd International Conference on Rest, New York, N.Y., 28 Aug. 1987
 Sponsored in cooperation with ONR
 (Contract NCC2-286)
 (NASA-CR-180621; NAS 1.26:180621) Avail: NTIS HC A02/MF A01 CSCL 05I

Research into the impact of personality factors on groups in various settings is reviewed as an introduction to a brief discussion of personality and group behavior research needs relevant to the space program. Significant findings of some earlier research are summarized, and methodological problems are touched on. The study of intergroup and intragroup conflict in a stressful environment, as exemplified particularly by undersea habitats, is seen as being of consequence for long-term space missions. It is concluded that adequate research can only be conducted as an adjunct to data collection from operational stressful environments, and not from laboratory experiments. J.P.B.

N87-27398*# Texas Univ., Austin. Dept. of Psychology.
HUMAN PERFORMANCE IN AEROSPACE ENVIRONMENTS: THE SEARCH FOR PSYCHOLOGICAL DETERMINANTS
 ROBERT L. HELMREICH and JOHN A. WILHELM 1987 35 p
 (Contract NCC2-286)
 (NASA-CR-180326; NAS 1.26:180326) Avail: NTIS HC A03/MF A01 CSCL 05I

A program of research into the psychological determinants of individual and crew performance in aerospace environments is described. Constellations of personality factors influencing behavior in demanding environments are discussed. Relationships between attitudes and performance and attitudes and personality are also reported. The efficacy of training in interpersonal relations as a means of changing attitudes and behavior is explored along with the influence of personality on attitude change processes. Finally, approaches to measuring group behavior in aerospace settings are described. Author

N87-27399*# Texas Univ., Austin. Dept. of Psychology.
MAKING IT WITHOUT LOSING IT: TYPE A, ACHIEVEMENT MOTIVATION, AND SCIENTIFIC ATTAINMENT REVISITED
 ROBERT L. HELMREICH, JANET T. SPENCE, and ROBERT S. PRED 1987 25 p
 (Contract NCC2-286)
 (NASA-CR-180321; NAS 1.26:180321) Avail: NTIS HC A02/MF A01 CSCL 05I

In a study by Matthews et al. (1980), responses by academic psychologists to the Jenkins Activity Survey for Health Prediction, a measure of the Type A construct, were found to be significantly, positively correlated with two measures of attainment, citations by others to published work and number of publications. In the present study, JAS responses from the Matthews et al. sample were subjected to a factor analysis with oblique rotation and two new subscales were developed on the basis of this analysis. The first, Achievement Strivings (AS) was found to be significantly correlated with both the publication and citation measures. The second scale, Impatience and Irritability (I/I), was uncorrelated with the achievement criteria. Data from other samples indicate that I/I is related to a number of health symptoms. The results suggest that the current formulation of the Type A construct may contain two components, one associated with positive achievement and the other with poor health. Author

N87-27400*# Texas Univ., Austin. Dept. of Psychology.
IMPATIENCE VERSUS ACHIEVEMENT STRIVINGS IN THE TYPE A PATTERN: DIFFERENTIAL EFFECTS ON STUDENTS' HEALTH AND ACADEMIC ACHIEVEMENT
 JANET T. SPENCE, ROBERT L. HELMREICH, and ROBERT S. PRED 1987 44 p
 (Contract NAG2-137)
 (NASA-CR-180693; NAS 1.26:180693) Avail: NTIS HC A03/MF A01 CSCL 05I

Psychometric analyses of college students' responses to the Jenkins Activity Survey, a self-report measure of the Type A behavior pattern, revealed the presence of two relatively independent factors. Based on these analyses, two scales, labeled Achievement Strivings (AS) and Impatience and Irritability (II), were developed. In two samples of male and female college students, scores on AS but not on II were found to be significantly correlated with grade point average. Responses to a health survey, on the other hand, indicated that frequency of physical complaints was significantly correlated with II but not with AS. These results suggest that there are two relatively independent factors in the Type A pattern that have differential effects on performance and health. Future research on the personality factors related to coronary heart disease and other disorders might more profitably focus on the syndrome reflected in the II scale than on the Type A pattern. Author

N87-27401# Admiralty Research Establishment, Teddington (England).
AUTOMATICITY AND THE CAPTURE OF ATTENTION BY A PERIPHERAL DISPLAY CHANGE
 N. K. MOHINDRA, E. SPENCER, and A. LAMBERT Dec. 1986 16 p
 (ARE-TM(AXB)86503; BR101672; ETN-87-90091) Avail: NTIS HC A02/MF A01

The proposal that peripheral visual changes (cues) tend to summon attention automatically was tested by studying the effect of peripheral cueing on simple detection latency. Delay between cue onset and target onset, the contingent relationship between cue location and target location, and instructions to subjects were manipulated. Results show that a peripheral display change captures attention even when the target is far more likely to appear at an uncued location. When subjects were explicitly informed that targets were likely to appear away from the cued location they can suppress this effect, but are unable to completely reverse it by rapidly orienting attention towards the uncued side. Hence the process appears to be automatic in the sense that it occurs unless there are explicit instructions to the contrary. With explicit

instructions the processing operation can be suppressed, but not completely reversed. ESA

N87-28252# Air Force Human Resources Lab., Brooks AFB, Tex.

TIME-SHARING ABILITY AS A PREDICTOR OF FLIGHT TRAINING PERFORMANCE Interim Technical Paper Jan. 1983 - Sep. 1986

THOMAS R. CARRETTA Jun. 1987 16 p
(AD-A181838; AFHRL-TP-86-69) Avail: NTIS HC A02/MF A01 CSCL 051

Modern-day pilots must perform a variety of activities concurrently. In addition to flying the aircraft, they must monitor the communications channels and instrument panel and also navigate. As a result, the ability to allocate attention to different tasks effectively or time share is crucial for a safe, well-executed flight. A compensatory tracking and signal detection dual-task was administered to 1,130 United States Air Force pilot training candidates prior to entry into Undergraduate Pilot Training (UPT). Tracking performance was extremely reliable. Although performance on this task was not predictive of successful completion of UPT, it was related significantly to a post-UPT advanced training recommendation. This task may be useful when it is desirable to place candidates into specialized training tracks at an early point in training. GRA

N87-28253*# Texas Univ., Austin. Dept. of Psychology.
STUDYING FLIGHT CREW BEHAVIOR: A SOCIAL PSYCHOLOGIST ENCOUNTERS THE REAL WORLD

ROBERT L. HELMREICH 1986 18 p Presented at the Annual Meeting of the American Psychological Association, Washington, D.C., Aug. 1986
(Contract NAG2-137)
(NASA-CR-180284; NAS 1.26:180284) Avail: NTIS HC A02/MF A01 CSCL 051

Considerable social psychological research has been conducted on the relationship between personality and performance in various occupational settings. Of special interest are situations where the performer is under pressure or the consequences of poor performance can be serious, as in aircraft operation. Some significant findings are summarized, including those related to Type A personality factors, achievement motivation factors, and attitude factors. Future research should focus on group behavior. J.P.B.

N87-28254# European Space Agency, Paris (France).
REGULATION OF PERFORMANCE AND MONITORING OF ERRORS IN A TEST OF PERCEPTUAL SPEED

KLAUS-MARTIN GOETERS Jan. 1987 39 p Transl. into ENGLISH of "Leistungsregulation und Fehlerkontrolle in einen Aufmerksamkeitsstest mit Geschwindigkeitskomponente" Original language document was announced as N87-12164
(ESA-TT-1010; DFVLR-FB-86-13; ETN-87-90010) Avail: NTIS HC A03/MF A01; original German version available from DFVLR, Cologne, West Germany DM 15

A test of perceptual speed (cancellation of figures) in which usually the number of rights and wrongs (omissions) are uncorrelated, was applied to three groups with different instructions. Group 1 was told to work quickly and accurately; group 2 to take care of the speed of work, and group 3 of accuracy. Subjects who were asked by a questionnaire about their attitudes during the work period and about their general style of work, emphasized the factors speed or accuracy while neglecting the other components. This procedure does not achieve the expected success. The result confirms the functional independence of speed of work and error rate in tests of mental concentration. ESA

N87-28255# European Space Agency, Paris (France).

THE VALUE OF GLOBAL SELF-RATINGS IN DIFFERENTIAL DIAGNOSTICS

PETER MASCHKE Mar. 1987 248 p Transl. into ENGLISH of "Zum Wert globaler Selbsteinschaetzungen in der Differentiellen Diagnostik, Hamburg, West Germany, Original language document was announced as N87-12165

(ESA-TT-1014; DFVLR-FB-86-20; ETN-87-90012) Avail: NTIS HC A11/MF A01; original German version available from DFVLR, Cologne, West Germany DM 66.50

Reliability validity and faking tendencies of a 10 dimensional personality inventory were compared with the corresponding global self ratings in a situation of job application. Global self ratings do not appear to be faked more than the personality test scales. Although there are distinct differences in reliability between self rating and personality scales, the latter attain only negligibly higher validities. Reasons for these results (unexpected from assumptions of classical testing theory) are discussed. In relation to self ratings in performance, there are indications of a capability of self assessment. ESA

N87-28256# Systems Control Technology, Inc., Arlington, Va.
AERONAUTICAL DECISION MAKING FOR STUDENT AND PRIVATE PILOTS Final Report

ALAN E. DIEHL, PETER V. HWOSCHINSKY, RUSSELL S. LAWTON, and GARY S. LIVACK May 1987 111 p Prepared in cooperation with AOPA Air Safety Foundation, Frederick, Md.
(Contract DTFA01-80-C-10080)
(AD-A182549; DOT/FAA/PM-86/41) Avail: NTIS HC A06/MF A01 CSCL 01B

Aviation accident data indicate that the majority of aircraft mishaps are due to judgment error. This manual is part of a project to develop materials and techniques to help improve pilot decision making. Training programs using prototype versions of these materials have demonstrated substantial reductions in pilot error rates. The results were statistically significant and ranged from approximately 10% to 50% fewer mistakes. This manual is designed to explain the risks associated with Student and Private pilot flying activities, the underlying behavioral causes of typical accidents, and the effects of stress on pilot decision making. It provides a means for the individual pilot to develop an attitude profile through a self-assessment inventory and provides detailed explanations of preflight and in-flight stress management techniques. The assumption is that pilots receiving this training will develop a positive attitude toward safety and the ability to manage stress effectively while recognizing and avoiding unnecessary risk. This manual is one of a series on Aeronautical Decision-Making prepared for the following pilot audiences: (1) student and private; (2) commercial; (3) instrument; (4) instructor; (5) helicopter, and (6) multicrew. GRA

N87-28257# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

GENERATION MODELS OF DECISION RULES: A CENTRAL APPROACH TO INDUCTIVE LEARNING M.S. Thesis [GERACAO DE MODELOS DE REGRAS DE DECISAP: UMA ABORDAGEM CENTRADA NA APRENDIZAGEM INDUTIVA]

PEDRO PAULO BALBIDEOLIVEIRA Aug. 1987 167 p In PORTUGUESE; ENGLISH summary
(INPE-4299-TDL/276) Avail: NTIS HC A08/MF A01

Research for the creation of a mechanism to allow the generation of models (descriptions) of the rules which constitute a knowledge base is presented. The mechanism which was defined is based on an inductive learning process which is proposed, and works from rule classes defined in the base. Such classes are composed of rules which have some common conclusion clause and refer to a same set of objects. The learning approach allows the creation of disjunctive and conjunctive concepts. This process allows the generalization of disjunctive concepts for another that encompasses the former, which represents a simple way of knowledge-based learning. The learning mechanism was tested only for generation of characteristic descriptions, but, as it tried to show, it could also be used for the generation of discriminant

descriptions. The results obtained, as well as the acquired experience, allow the conclusion that, in order that the models may better specify the knowledge expressed in the base, more sophisticated ways of defining the rule classes are necessary.

Author

54

MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

A87-47111

DYNAMIC ANALYSIS OF INERTIAL LOADING EFFECTS OF HEAD MOUNTED SYSTEMS

EBERHARDT PRIVITZER (Arvin/Calspan Advanced Technology Center, Buffalo, NY) and JEFFREY J. SETTECERRI (Systems Research Laboratories, Inc., Dayton, OH) SAFE Journal, vol. 17, Summer 1987, p. 16-22. refs

The Head-Spine Model (HSM) is a discretized idealization of the human head-spine system. It was developed to provide a mathematical approach for the investigation of three-dimensional head-spine structure dynamic response and injury likelihood in impact environments. A program is described in which the HSM is being used to study the inertial loading effects, on the neck and upper spine, associated with head or helmet mounted systems. Results are presented from a series of HSM ejection simulations which considered the effects of variations in mass and location of 'generic' head encumbering devices, i.e., 1, 2, and 3 kg point masses.

Author

A87-47113

ACCELERATION LOADING TOLERANCE OF SELECTED NIGHT VISION GOGGLE SYSTEMS - A MODEL ANALYSIS

M. I. DARRAH, C. R. SEEVERS (McDonnell Douglas, Astronautics Co., Saint Louis, MO.), A. J. WANG, and D. W. DEW (McDonnell Douglas Aircraft Co., Saint Louis, MO) SAFE Journal, vol. 17, Summer 1987, p. 30-36. refs

The effect of increased helmet/head weight on homeostatic and ejection acceleration tolerance is investigated using a modified head/neck stress model and an articulated total body model. The night vision imaging systems studied were the Cats Eyes, AN/AVS-6, and FJW Industries Concept II Night Vision Goggles. The data reveal that crew tolerance to sustained acceleration is degraded to below 3.5 +Gz and the applied neck torque is increased to a minimum of 267.7 inch lb. It is also observed that the pitch-producing moment and possibility of spinal injury during ejection are increased. It is noted that the weight of currently used night vision goggle systems limit homeostatic performance to about 4.0 +Gz and increase the likelihood of ejection injury; however, they do not affect interior/crew station vision.

I.F.

A87-47114

INITIAL CENTRIFUGE TESTS OF A SUBJECT CONTROLLABLE ANTI-G VALVE

JOHN W. FRAZIER, DAVID A. RATINO, HARRY G. ARMSTRONG (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH), CHARLES D. GOODYEAR (Systems Research Laboratories, Inc., Dayton, OH), LAWRENCE H. GOULD (Raytheon Service Co., Burlington, MA) et al. SAFE Journal, vol. 17, Summer 1987, p. 38-44. refs

A closed-loop, subject-controlled anti-G valve developed to control anti-G suit pressure is described and tested. The tests were conducted in the Dynamic Environment Simulator; eight subjects selected opening points from 1.6-1.64 Gz and G-suit pressures of 5.1-5.3 psi at 5 Gz during three gradual onset (0.1, 0.2, and 0.4 G/sec) runs to 5 Gz. It is observed that there is no difference in the opening points selected by the subjects for the

three gradual onset ramp conditions and the mean G-suit pressures selected by the subjects were similar and within military specifications. For 30 sec plateau tests at 3, 4, and 5 Gz, the mean G-suit pressure selected by the subjects were 0.8, 2.8, and 5.3 psi, respectively, and the military specifications of midrange G-suit pressure at 3, 4, and 5 Gz are 2.0., 3.5, and 5.0 psi, respectively. The data also reveal that at G levels greater than 6 Gz the subjects preferred more G-suit pressure than that provided by the standard anti-G valve.

I.F.

A87-47115

EVALUATION OF FALL PROTECTION EQUIPMENT BY PROLONGED MOTIONLESS SUSPENSION OF VOLUNTEERS

MARY ANN ORZECZ, JAMES W. BRINKLEY, MARK D. GOODWIN, MARK D. SALERNO, and JOHN SEAWORTH (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) SAFE Journal, vol. 17, Summer 1987, p. 46-53. refs

The capabilities of three types of fall protection harnesses to provide occupant body support and restraint during post-fall suspension were evaluated using thirteen subjects. The three types of fall protection harnesses are: (1) the body belt, (2) the chest harness, and (3) the full-body harness. Physiological effects, suspension duration, tolerance, and subjective responses to prolonged motionless suspension are analyzed. Blood pressure, heart rate, and respiratory rate were also measured. It is observed that the mean suspension duration for the full-body harness is 14.38 minutes, 6.08 minutes for the chest harness, and 1.63 minutes for the body belt. It is noted that the full-body harness exhibits a longer mean suspension duration than the other harnesses and body support is improved by distributing loads over bony structures.

I.F.

A87-49030

RADIATION PROTECTION PROBLEMS FOR THE SPACE STATION AND APPROACHES TO THEIR MITIGATION

H. BUECKER and R. FACIUS (DFVLR, Institut fuer Flugmedizin, Cologne, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 305-314. refs

This paper considers the radiation protection standards, the systems of dosimetric surveillance, and the possible methods of selective shielding for a space station. The problems that need to be investigated include the composition of the external radiation field and the variability in space and time in the conditions of the radiation field, the spacecraft shielding interaction, the effects of the depth-dose distribution, the unique HZE effects, the relative contribution of the separate radiation components to the total dose equivalent deposited in man's critical organs, and a possible contribution to radiation-affected damage by microgravity. The need of a radiation monitoring system and personnel dosimeters is emphasized.

I.S.

A87-49031* San Francisco Univ., Calif.

SUMMARY OF RADIATION DOSIMETRY RESULTS ON U.S. AND SOVIET MANNED SPACECRAFT

E. V. BENTON (San Francisco, University, CA) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) Advances in Space Research (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 315-328. refs
(Contract NAS9-15152; NAS9-17389)

Measurements of the radiation environment aboard U.S. and Soviet manned spacecraft are reviewed and summarized. Data obtained mostly from passive and some active radiation detectors now exist for the case of low-earth-orbit missions. Major uncertainties still exist for space exposure in high-altitude, high-inclination geostationary orbits, in connection with solar effects and that of shielding. Data from active detectors flown in Spacelabs 1 and 2 suggest that a variety of phenomena must be understood

before the effects of long-term exposure at the Space Station type of orbit and shielding can be properly assessed. Author

A87-49033**RADIATION PROTECTION STANDARDS IN SPACE**

WARREN SINCLAIR, K. (National Council on Radiation Protection and Measurements, Bethesda, MD) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/17, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 335-343. refs

The recommendations of the NCRP and ICRP concerning the limits of individual daily exposure to ionizing radiation are discussed together with the levels of organ doses expected to be received by the personnel of various missions, such as the Space Station, Polar Orbiter, Mars, and lunar missions and a GEO sortie, are examined. The circumstances of space travel suggest approaches to limits similar to those for radiation workers on the ground, such as a career limit apportioned according to the type of mission, the approach presently considered by the NCRP. Tentative recommended career, annual, and 30-day dose equivalent limits for the eye, skin, and the blood-forming organs and for the lifetime excess risk of fatal cancer are presented. I.S.

A87-49162#**THE EFFECTS OF TIME DELAY AND SIMULATOR MODE ON CLOSED-LOOP PILOT/VEHICLE PERFORMANCE - MODEL ANALYSIS AND MANNED SIMULATION RESULTS**

WILLIAM H. LEVISON and BRUCE PAPAIZAN (BBN Laboratories, Inc., Cambridge, MA) IN: AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1987, p. 39-49. refs (AIAA PAPER 87-2371)

The optimal control model for pilot/vehicle systems was used in the design of a manned simulation study performed by Arvin/Calspan and in the interpretation experimental results. Experimental variables included: (1) control system delay, (2) simulated aircraft dynamics, and (3) simulator mode (ground base or in-flight). Rms error trends observed experimentally generally conformed to pre- and postexperiment model predictions. The (adverse) effects of delay on tracking performance were slightly greater for a simulated high-performance fighter flown aggressively than for a simulated heavy transport flown in a less demanding task; delay effects were somewhat greater in the ground simulator than in flight; and differences between in-flight and ground simulator performance were relatively small for tasks with no added delay. There was some evidence of pilot response nonlinearity. The generally good agreement between predicted and experimental performance metrics (both rms errors and pilot frequency response) suggests that a viable technique for determining time delay requirements can be based on the joint use of simulation and model analysis. Author

A87-49163#**TEMPORAL FIDELITY IN AIRCRAFT SIMULATOR VISUAL SYSTEMS**

MICHAEL S. MERRIKEN, WILLIAM V. JOHNSON (Systems Research Laboratories, Inc., Dayton, OH), and GARY E. RICCIO (USAF, Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH) IN: AIAA Flight Simulation Technologies Conference, Monterey, CA, Aug. 17-19, 1987, Technical Papers. New York, American Institute of Aeronautics and Astronautics, 1987, p. 50-54. refs (AIAA PAPER 87-2372)

This paper will discuss a research effort of the Armstrong Aerospace Medical Research laboratory to investigate the effects of temporal fidelity in aircraft simulator visual systems. A review of the pertinent previous research is presented first followed by an overview of the research approach taken by the Human Engineering Division. A summary of the completed research to

date, with the salient results, is then presented. Finally, the program plan for the next phase of research is discussed. Author

A87-49967#**LIFE SUPPORT SUBSYSTEM CONCEPTS FOR BOTANICAL EXPERIMENTS OF LONG DURATION**

H. LOESER (MBB-ERNO Raumfahrttechnik GmbH, Bremen, West Germany) Intersociety Conference on Environmental Systems, 16th, San Diego, CA, July 14-16, 1986, Paper. 18 p. refs (MBB-UR-E-907-86-PUB)

The likely requirements (in terms of air temperature, relative humidity, composition of atmosphere, and fluids control) of the Life Support Subsystem (LSS) designed for orbital botanical facilities to be flown on Eureka and those of the Environmental Control and Life Support Subsystem (ECLSS) designed for the Columbus carrier are compared. It was found that, while many requirements for the LSS and ECLSS are identical or similar, two requirements (the desired CO₂ partial pressure and relative humidity) are not. On the basis of these results, various LSS concepts are discussed which would interact to varying degrees with the ECLSS (in a sense that the ECLSS would be used as a resource for the consumables needed by the LSS). Consideration is given to the advantages and disadvantages of such interaction, in particular the weight savings and technical complexity. I.S.

A87-50313**SCOTT EMERGENCY ESCAPE BREATHING DEVICE EVALUATION FOR USE BY AIRCRAFT CABIN CREW AND PASSENGERS**

N. A. MARTIN and J. R. POPFLOW (Defence and Civil Institute of Environmental Medicine, Downsview, Canada) *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Aug. 1987, p. 747-753. refs

An emergency escape breathing device (EEBD) was evaluated for use in Canadian Forces (CF) transport/passenger aircraft in providing smoke protection during emergencies and in preventing hypoxia during cabin decompression at high altitude. Five human subjects wearing the EEBD were subjected to decompression from 2438 m to 9753 m in approximately 15 s followed by a free fall to 7010 m in a challenge gas atmosphere of 5000 ppm of carbon monoxide (CO), where they performed moderate exercise (80 W output) on a bicycle ergometer. Very little in-leakage of CO was observed when the neck seal was maintained. Hood atmosphere was measured at 97 percent oxygen at 7010 m, which resulted in an arterial oxygen saturation of 97 percent. Temperature in the hood rose to as high as 45.5 C, but the subjects were able to function normally. The EEBD is effective in providing noncockpit aircraft crew with smoke protection, adequate vision, and hypoxia prevention for at least 15 min in the event of a fire, smoke, or decompression emergencies at altitudes up to 7010 m following a brief exposure to 9753 m. Author

A87-50324**PILOT STUDIES OF VAPOR TRANSFER THROUGH BREATHABLE OUTERWEAR BY SIMULATING SWEATING IN THE COLD**

D. J. BOTHE, R. S. POZOS (Wisconsin, University, Green Bay; Minnesota, University, Duluth), and W. C. KAUFMAN *Aviation, Space, and Environmental Medicine* (ISSN 0095-6562), vol. 58, Aug. 1987, p. 812-816. Research supported by the Minnesota Medical Foundation. refs

Claims that rainproof films allow the unimpeded evaporation of sweat have been examined by modifying a heat transfer method to include evaporation of water. This physical study simulates a casual hiker (2 mets) in 4 C dry weather wearing clothing of 1.5-2.0 clo and sweating at 40 g/h. Goose down, wool, polyester, and polyolefin fills were combined with no protective cover, Gore-Tex, and polyurethane covers. No significant differences in insulation between dry (control) and wet (stabilized evaporation) occurred. Neither cover nor fill had significant effects on heat transfer. Total water evaporated (sweat produced) was affected only by the wool filler. A significantly greater amount of water was trapped by the natural fibers and the polyurethane cover. These

data indicate that breathable rainwear is likely to have little effect on heat transfer, even though it allowed 89 percent of sweat to evaporate compared to 51 percent for the polyurethane raincoat.

Author

A87-50325

A COMPUTERIZED SYSTEM FOR MEASURING DETECTION SENSITIVITY OVER THE VISUAL FIELD

JOHN L. KOBRICK, ADRIEN R. LUSSIER, STEPHEN MULLEN, and CALVIN WITT (U.S. Army, Research Institute of Environmental Medicine, Natick, MA) Aviation, Space, and Environmental Medicine (ISSN 0095-6562), vol. 58, Aug. 1987, p. 817-819. refs

A device is described for comprehensively measuring the capability of human operators to detect and react to visual signals occurring at a variety of locations throughout the functional visual field. The system is completely automated and computerized, and provides both documentation files and descriptive graphics of the operator's performance immediately upon completion of testing. Sensitivity of detection can be measured for red, yellow, and green stimulus colors in a testing configuration which mimics commonplace surveillance of the ordinary viewing field. An abbreviated listing of the main operating program software is provided.

Author

N87-27402# Human Machine Interfaces, Inc., Knoxville, Tenn. THE IMPLICATIONS OF FORCE REFLECTION FOR TELEOPERATION IN SPACE

J. V. DRAPER, J. N. HERNDON, and W. E. MOORE 1987 24 p Presented at the Goddard Conference on Space Applications of Artificial Intelligence and Robotics, Greenbelt, Md., 14 May 1987 Prepared in cooperation with Oak Ridge National Lab., Tenn.

(Contract DE-AC05-84OR-21400)

(DE87-008585; CONF-870591-1) Avail: NTIS HC A02/MF A01

Previous research on teleoperator force feedback is reviewed and results of a testing program which assessed the impact of force reflection on teleoperator task performance are reported. Force reflection is a type of force feedback in which the forces acting on the remote portion of the teleoperator are displayed to the operator by back-driving the master controller. The testing program compared three force reflection levels: 4 to 1 (four units of force on the slave produce one unit of force at the master controller), 1 to 1, and infinity to 1 (no force reflection). Time required to complete tasks, rate of occurrence of errors, the maximum force applied to tasks components, and variability in forces applied to components during completion of representative remote handling tasks were used as dependent variables. Operators exhibited lower error rates, lower peak forces, and more consistent application of forces using force reflection than they did without it. These data support the hypothesis that force reflection provides useful information for teleoperator users. The earlier literature and the results of the experiment are discussed in terms of their implications for space based teleoperator systems. The discussion describes the impact of force reflection on task completion performance and task strategies, as suggested by the literature. It is important to understand the trade-offs involved in using telerobotic systems with and without force reflection. DOE

N87-27403# Florida Inst. of Tech., Melbourne.

HUMAN PERFORMANCE TASK BATTERIES AND MODELS: AN ABILITIES-BASED DIRECTORY Final Report, 6 Sep. 1985 - 30 Nov. 1986

DANIEL J. POND, DEBORAH L. DESROCHERS, and JAMES E. DRISKELL 1 Dec. 1986 96 p

(Contract DAAG29-81-D-0100)

(AD-A180751; NTSC-TR-86-020) Avail: NTIS HC A05/MF A01

CSSL 05H

This Directory represents the start of a research program directed towards the creation of a human abilities matrix which cross-references data on real world jobs, laboratory performance tasks, and human performance models. The matrix will use the abilities requirements approach of Fleishman & Quaintance (1984) as the unifying element among these three dimensions. The present

effort compiles and cross-references information on computer-based performance assessment batteries and models/theories of human performance. Data from ten batteries, one hundred twenty-three tasks, and seven models have been included. For the performance batteries, this information includes availability/acquisition details as well as computer hardware and software characteristics. This document, then, enables researchers to quickly access such data as well as to ascertain those areas in which a paucity of data exists. GRA

N87-27404# Naval Postgraduate School, Monterey, Calif. EXPERIMENTAL STUDIES OF JOINT FLEXIBILITY FOR PUMA 560 ROBOT M.S. Thesis

DENNIS K. GONYIER Mar. 1987 63 p

(AD-A181451) Avail: NTIS HC A04/MF A01 CSCL 13I

There is a potential in the Navy and the Department of Defense for the utilization of robot manipulators in a wide range of applications. First, they could be used in applications that are performed in environments dangerous to men. These include underwater work, fire fighting, tank and void preservation and reactor spaces. Second, many patrol and/or security functions could be performed by robot releasing the operator to a position of supervisory control over many units. Third, robotic submersibles are being used now to explore areas of our undersea environment that were out of economical range before their use. This will lead to a closer determination of the resources available in our oceans and their subsequent exploitation. There is also a large potential for the use of robots in space. The weight limitations will demand manipulators to be flexible compared to the industrial machines currently available. The problems of control of these flexible arms will have to be studied prior to their implementation. In addition, the robot manipulators currently installed in industry have the potential for increased productivity if their performance could be enhanced. This latter requires an understanding of the flexibility effects and their integration into the control algorithm. GRA

N87-27405*# Texas Univ., Austin. Dept. of Psychology. THE UNDERSEA HABITAT AS A SPACE STATION ANALOG: EVALUATION OF RESEARCH AND TRAINING POTENTIAL

ROBERT L. HELMREICH and JOHN A. WILHELM 1 Oct. 1985 20 p

(Contract NCC2-286)

(NASA-CR-180342; NAS 1.26:180342) Avail: NTIS HC A02/MF A01 CSCL 05H

An evaluation is given of the utility of undersea habitats for both research and training on behavioral issues relative to the space station. The feasibility of a particular habitat, La Chalupa, is discussed. Author

N87-27406*# Texas Univ., Austin. Dept. of Psychology. LIVING IN CONTAINED ENVIRONMENTS: RESEARCH IMPLICATIONS FROM UNDERSEA HABITATS

ROBERT L. HELMREICH 1986 15 p Presented at Individuals and Group Behavior in Toxic and Contained Environments: A Conference to Explore the Psychological Effects of Chemical and Biological Warfare, Austin, Tex., 13 Dec. 1986

(Contract NCC2-286)

(NASA-CR-180341; NAS 1.26:180341) Avail: NTIS HC A02/MF A01 CSCL 05H

A cost-reward model is used to frame a discussion of differences in observed behavior of individuals and groups in confined environments. It has been observed that the high cost of functioning in a stressful environment is likely to produce poor performance when anticipated rewards are low but that participants can manage the stress and achieve high performance if they anticipate high rewards. The high-reward environment is exemplified by early undersea habitats such as Sealab and Teklite and by early space missions. Other aspects of behavior occur in all confined environments and point to an important area for future research. Of particular interest are intergroup conflicts arising between the confined group and its external control. Also, individual differences in personality seem always to have an impact in confined environments. Recent research has focused on: (1) predicting

performance and adjustment based on instrumental and expressive aspects of the self; (2) the differential predictive power of achievement striving and irritation/irritability in Type A personalities; and (3) the nature and role of leadership in small, isolated groups. J.P.B.

N87-27407*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

SPACE SUIT EXTRAVEHICULAR HAZARDS PROTECTION DEVELOPMENT

JOSEPH J. KOSMO 14 Jan. 1987 32 p
(NASA-TM-89355; NAS 1.15:89355) Avail: NTIS HC A03/MF A01 CSCL 06K

Presented is an overview of the development of the integral thermal/micrometeoroid garment (ITMG) used for protection of a space-suited crewmember from hazards of various extravehicular environments. These hazard conditions can range from thermal extremes, meteoroid and debris particles, and radiation conditions in near-earth orbits and free space to sand and dust environments encountered on lunar or planetary surfaces. Representative ITMG materials cross-section layouts are identified and described for various space-suit configurations ranging from the Gemini Program to planned protective requirements and considerations for anticipated Space Station EV operations. Author

N87-27408# Oak Ridge National Lab., Tenn.

REMOTE HANDLING FACILITY AND EQUIPMENT USED FOR SPACE TRUSS ASSEMBLY

T. W. BURGESS 1987 8 p Presented at the Goddard Conference on Space Applications of Artificial Intelligence and Robotics, Greenbelt, Md., 14 May 1987
(Contract DE-AC05-84OR-21400)
(DE87-009121; CONF-870591-3) Avail: NTIS HC A02/MF A01

The ACCESS truss remote handling experiments were performed at Oak Ridge National Laboratory's (ORNL's) Remote Operation and Maintenance Demonstration (ROMD) facility. The ROMD facility has been developed by the US Department of Energy's (DOE's) Consolidated Fuel Reprocessing Program to develop and demonstrate remote maintenance techniques for advanced nuclear fuel reprocessing equipment and other programs of national interest. The facility is a large-volume, high-bay area that encloses a complete, technologically advanced remote maintenance system that first began operation in FY 1982. The maintenance system consists of a full complement of teleoperated manipulators, manipulator transport systems, and overhead hoists that provide the capability of performing a large variety of remote handling tasks. ACCESS truss remote assembly was performed in the ROMD facility using the Central Research Laboratory's (CRL) model M-2 servomanipulator. The model M-2 is a dual-arm, bilateral force-reflecting, master/slave servomanipulator which was jointly developed by CRL and ORNL and represents the state of the art in teleoperated manipulators commercially available in the United States today. The model M-2 servomanipulator incorporates a distributed, microprocessor-based digital control system and was the first successful implementation of an entirely digitally controlled servomanipulator. The system has been in operation since FY 1983. DOE

N87-27409*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A NEW ILLUSION OF PROJECTED THREE-DIMENSIONAL SPACE

STEPHEN R. ELLIS and ARTHUR GRUNWALD Jul. 1987 11 p
(NASA-TM-100006; A-87285; NAS 1.15:100006) Avail: NTIS HC A02/MF A01 CSCL 05H

When perspective projections of orbital trajectories plotted in local-vertical local-horizontal coordinates are viewed with certain viewing angles, their appearance becomes perceptually unstable. They often lose their trochoidal appearance and reorganize as helices. This reorganization may be due to the viewer's familiarity with coiled springs. Author

N87-28258# Human Engineering Labs., Aberdeen Proving Ground, Md.

HUMAN FACTORS RESEARCH SIMULATOR Final Report

GORDON L. HERALD Mar. 1987 34 p
(AD-A180816; HEL-TM-8-87) Avail: NTIS HC A03/MF A01 CSCL 05H

The development of a simulation capability to be used for a broad range of Army human factors research is described, including a low cost terrain imaging system that uses commercial off the shelf hardware. Design problems and consideration regarding aviation and air defense human factors simulators are discussed. An example of an aviation baseline system is included. GRA

N87-28259# Systems Control Technology, Inc., Dayton, Ohio.

A COCKPIT NATURAL LANGUAGE STUDY: DATA COLLECTION AND INITIAL DATA ANALYSIS Final Report, Oct. 1985 - Sep. 1986

GRETCHEN D. LIZZA, MICHAEL P. MUNGER, RONALD L. SMALL, GREGORY L. FEITSHANS, and STEPHEN D. DETRO Apr. 1987 377 p
(Contract F33615-85-C-3623; AF PROJ. 2403)
(AD-A181306; SCT-5529-07; AFWAL-TR-87-3003) Avail: NTIS HC A17/MF A01 CSCL 05G

This report describes an initial attempt to study language used by fighter pilots. To this end, a methodology was adopted which entailed the use of a mission scenario, tape recording the experimental sessions, and analyzing the data according to various statistical and tabular methods. Fifty-four pilots from six organizations participated in the study and generated 656 unique words, abbreviations, and acronyms. The data base created in this study is meant to be a foundation for additional analyses. The statistical tables can provide researchers with sufficient descriptive material to define and conduct studies focusing on particular issues and hypotheses. Some of the major conclusions are: (1) the data gathering method and statistical/tabulation procedures are appropriate for this type of knowledge engineering; (2) as measured by vocabulary and rating scores, the sample was homogeneous with respect to differences among bases, aircraft, and pilots; (3) variations in vocabulary within situations are due to the pilots; and (4) variations in vocabulary across situations are due both to pilots and to differing task demands. GRA

N87-28260# Sener, S.A., Madrid (Spain).

SERVICE MANIPULATOR ARM (SMA) FOR A ROBOTIC SERVICING EXPERIMENT (ROSE) Final Report

M. FUENTES, C. COMPOSTIZO, F. DOBLAS, A. MARTINEZ, E. DELAFUENTE, R. GONZALO, J. L. LACOMBE, G. BERGER, and T. BLAIS Paris, France ESA Jun. 1986 106 p
(Contract ESTEC-6174/85-NL-AN(SC))
(ESA-CR(P)-2347; ETN-87-99994) Avail: NTIS HC A06/MF A01

The most important features of the Robotic Servicing Experiment (ROSE), where the servicing equipment such as the Service Manipulator System and the Orbit Replacement Units and the servicing operations are demonstrated in orbit within a representative scenario are identified. The shuttle was selected to carry all the necessary hardware and software into orbit and to provide resources required by the experiments. The in orbit operator will be located in the shuttle cabin or in a pressurized module close to the half pallet where the ROSE elements will be mounted inside the cargo bay. The ROSE and service manipulator arm development programs are outlined. ESA

N87-28261# Joint Publications Research Service, Arlington, Va.

USSR REPORT: ENGINEERING AND EQUIPMENT

23 Jun. 1987 76 p Transl. into ENGLISH from various Russian articles
(JPRS-UEQ-87-009) Avail: NTIS HC A05/MF A01

Topics addressed include: surface transportation, nuclear energy, industrial technology, turbine design, engine design, high-energy devices, optics, photography, and testing and materials.

N87-28262# Joint Publications Research Service, Arlington, Va.
DEVELOPMENT AND INVESTIGATION OF ACTIVE PNEUMATIC VIBRATION INSULATION SYSTEMS FOR HUMAN OPERATOR
 A. V. ANDREYCHIKOV *In its* USSR Report: Engineering and Equipment p 22-30 23 Jun. 1987 Transl. into ENGLISH from *Izvestiya Vysshikh Uchebnykh Zavedeniy: Mashinostroyeniye (Moscow, USSR)*, no. 2, Feb. 1987 p 94-98
 Avail: NTIS HC A05/MF A01

The results of full-scale investigations of the vibration-protection properties of three versions of pneumatic vibration-insulation systems for the seat of the human operator with pressure stabilizer are presented. The tests of the developed systems on modern high-speed 2TE116 and 2TE121 locomotives showed high effectiveness in the region of low and high vibration frequencies.

Author

N87-28263# Joint Publications Research Service, Arlington, Va.
APPLICATION OF AIR MICROJECTOR IN VACUUM GRIPPING DEVICE OF INDUSTRIAL ROBOT
 N. P. ZAPOROZHETS *In its* USSR Report: Engineering and Equipment p 28-30 23 Jun. 1987 Transl. into ENGLISH from *Mekhanizatsiya i Avtomatizatsiya Proizvodstva (Moscow, USSR)*, no. 12, Dec. 1986 p 25
 Avail: NTIS HC A05/MF A01

Calculation (optimization) of the principal geometrical and dynamic parameters of an air microjector is a rather complicated process. Therefore, the organization of experiments with an air microjector for the purposes of accumulating data is justified. A line diagram of a vacuum gripping device based on an air microjector with the ejecting stream fed peripherally is presented. In association with the inevitability of leaks originating between the suction device and the surface of the part, it is suggested that atmospheric air be drawn in and ejected into the atmosphere again. The relationship between the degree of vacuum and the air microjector's parameters are represented. Experimental curves describing the relationship are presented. The results obtained make it possible to optimize the principal parameters of an air microjector with the ejecting stream fed peripherally. B.G.

N87-28264# Ohio State Univ., Columbus.
HUMAN JOINT ARTICULATION AND MOTION-RESISTIVE PROPERTIES Final Report, 13 Sep. 1983 - 13 Jul. 1986
 ALI E. ENGIN and SHUENN-MUH CHEN Apr. 1987 185 p
 (Contract F33615-83-C-0510)
 (AD-A182574; AAMRL-TR-87-011) Avail: NTIS HC A09/MF A01
 CSCL 06D

Three-dimensional joint kinematics and motion resistive properties were measured for the shoulder, hip and elbow joints on ten male volunteers. A sonic three-dimensional spatial digitizing system was used to track multiple targets on adjacent body segments while each of the segments was moved through a maximum voluntary range of motion and also while it was subsequently forced to maximum voluntarily allowable ranges by an external force applicator. The data were used to reconstruct the segments kinematics, which were then related to the force required to attain given joint orientations. The final data are provided in a globographic presentation in which equal force values are depicted as contours on a global surface. The resistive forces are expressed as functions of the orientation angles in spherical harmonic expansion form. Statistical analyses have been performed on these data to generate both means and variances for the kinematics and resistive force properties. The data have direct applicability to better understanding of the kinematics of human long bone joints; providing preliminary limits for safe joint ranges of motion and forces; and serving as a data base for analytical and mechanical models of the human body. GRA

PLANETARY BIOLOGY

Includes exobiology; and extraterrestrial life.

A87-48484* George Washington Univ., Washington, D.C.
CHEMICAL EVOLUTION AND THE ORIGIN OF LIFE - BIBLIOGRAPHY SUPPLEMENT 1983
 LINDA G. PLEASANT, ROSE C. WADE (George Washington University, Washington, DC), and CYRIL PONNAMPERUMA (Maryland, University, College Park) *Origins of Life (ISSN 0302-1688)*, vol. 17, no. 2, 1987, p. 171-184. refs
 (Contract NASW-3165; NGR-21-002-317)

A87-48994
THE ORIGIN OF ADAPTATION AND DYSSYMMETRY IN THE EVOLUTION OF AUTOCATALYTIC SYSTEMS
 R. BUVET (Paris XII, Universite, Creteil, France) and J. M. DELARBRE (Ecole Nationale Supérieure de Technologie, Dakar, Senegal) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research (ISSN 0273-1177)*, vol. 6, no. 11, 1986, p. 13-15.

The evolution of open systems that include several autocatalytic processes in parallel or in series is mathematically analyzed. For the case of two reactions in parallel, such systems progressively and finally select the reaction pathway which involves the better autocatalyst. The effect of parameters influencing the rate of this evolution is discussed. Where catalysts are strictly equivalent, e.g., enantiomers in a symmetrical surrounding, the evolution is amplified by fluctuations and retains finally only one reaction pathway, if the autocatalytic rates of reactions are more than proportional to the catalyst concentrations. When including two reactions in series, these open systems are also able to give oscillations. Author

A87-48995
EARLY EMERGENCE OF PROTEIN PRECURSORS
 ANDRE BRACK (CNRS, Centre de Biophysique Moléculaire, Orleans, France) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research (ISSN 0273-1177)*, vol. 6, no. 11, 1986, p. 17, 18. refs

The prerequisites for the emergence of early protein precursors essential to primitive cell include (1) the selective aqueous polymerization of proteinaceous amino acids from a complex mixture of small molecules; (2) the selective resistance, via homochiral beta-sheet formation, of certain polypeptides to degradation, and (3) catalytic activity with respect to information transfer processes. The theoretical considerations concerning the possibility of satisfying these requirements in the course of chemical evolution are presented together with experimental evidence.

I.S.

A87-48996
THE STRUCTURAL ORGANIZATION OF POLYPEPTIDES AT THE AIR-WATER INTERFACE
 J. W. TAYLOR (Rockefeller University, New York) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research (ISSN 0273-1177)*, vol. 6, no. 11, 1986, p. 19-21. refs

The surface pressure-area isotherms generated by compressing monolayers formed by five polypeptide hormones at the air-water interface were studied. The results indicate that amphiphilic alpha-helical structures occupy the interfacial area, in agreement with predictions based only on the arrangements of the hydrophilic and hydrophobic amino-acid residues in the linear sequences of

these polypeptides. The variety of such arrangements, which result in the formation of stable helical structure, and their low degree of self-association, suggest that the induction of amphiphilic alpha-helical structure at suitable phase boundaries is likely to represent the earliest form of structural organization in polypeptides. Author

A87-48997
MINIMAL REQUIREMENTS FOR MOLECULAR INFORMATION TRANSFER

ALAN W. SCHWARTZ (Nijmegen, Katholieke Universiteit, Netherlands) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 23-27. refs

The information transfer properties of nucleic acids are largely due to the properties of the bases themselves, for which it would appear evolution has selected a highly favorable set of molecules. In aqueous solution, it is possible that this task can only be carried out efficiently by heterocyclic, condensed-ring structures fairly similar to the purines and pyrimidines. Alterations in backbone structure, however, whether in the mode of linkage or in the nature of the sugar residue, are much less critical. Such alternatives could have played a role in the emergence of life on earth and should be considered likely in extraterrestrial environments. The possible existence of low-efficiency, information transfer systems based on other structures entirely (proteins, clay minerals, etc), remains an interesting speculation for which no evidence is presently available. Author

A87-48998* Cornell Univ., Ithaca, N.Y.
THE EVOLUTION OF NUCLEOTIDES

D. A. USHER and M. C. NEEDELS (Cornell University, Ithaca, NY) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 29-32. refs (Contract NAGW-493; NIH-GM-07273)

Examples of chiral selection in nonenzymatic aminoacylation of internal 2-prime hydroxyl groups of oligo- and polynucleotides are discussed as an evidence for the early evolution of bionucleotides. Some factors that could influence the degree of this chiral selection and its direction are discussed. These include the structure of the aminoacyl component, the structure of the nucleoside component, and the reaction conditions. Investigation of the mechanism of this reaction was aided by the use of 3-prime inosine methyl phosphate (as a simplified model for a dinucleoside monophosphate) and proton NMR spectroscopy of t-butoxycarbonyl-alanyl esters of nucleosides as models for the transition state of the aminoacylation reaction itself. I.S.

A87-48999
HAVE DEOXYRIBONUCLEOTIDES AND DNA BEEN AMONG THE EARLIEST BIOMOLECULES?

HARTMUT FOLLMANN (Marburg, Universitaet, West Germany) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 33-38. DFG-supported research. refs

Unlike ribose chemistry, the chemistry of 2-deoxyribose precludes its formation or at least its incorporation into nucleotides under accepted 'primordial soup' conditions; therefore RNA and DNA could not develop in parallel during the evolution of protocells. However, deoxyribonucleotides might have been formed abiotically by direct reduction of ribonucleotides in a primitive version of the biochemical pathway. This sequence of events, in which DNA lagged behind RNA in the assembly of genetic information for an unknown - probably short - period of time is suggested by the

primitive traits (i.e., nucleotide binding, thiol redox chemistry, and metal ion catalysis) of present-day enzyme systems of deoxyribonucleotide biosynthesis. The reaction should be amenable to experimental study. Author

A87-49000* Instituto Politecnico Nacional, Mexico City.
STUDIES ON PRECELLULAR EVOLUTION - THE ENCAPSULATION OF POLYRIBONUCLEOTIDES BY LIPOSOMES

I. BAEZA, M. IBANEZ, J. C. SANTIAGO, C. WONG, A. LAZCANO (Instituto Politecnico Nacional, Mexico City, Mexico) et al. (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 39-43. refs (Contract NGR-44-005-002)

Liposomes have been suggested as possible models of precellular systems formed in the early Archean earth from lipids of nonenzymatic origin. Since it is generally accepted that RNA molecules preceded double-stranded DNA molecules as genetic material, the encapsulation of polyribonucleotides within liposomes (made from dipalmitoyl phosphatidylcholine and from egg yolk phosphatidylcholine) was studied. Quantitative determinations show that approximately 50 percent of the available lipids form liposomes, and that up to 5 percent of the polyribonucleotides can be entrapped by them. Also studied was the encapsulation of polyribonucleotides in the presence of urea and cyanamide and of Zn(2+) and Pb(2+). Author

A87-49003* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
IS THERE A SINGLE ORIGIN OF LIFE?

GERALD A. SOFFEN (NASA, Goddard Space Flight Center, Greenbelt, MD) (COSPAR and National Council on Radiation Protection and Measurements, Plenary Meeting, 26th, Topical Meeting and Workshop VII on Life Sciences and Space Research XXII/1/, Toulouse, France, June 30-July 11, 1986) *Advances in Space Research* (ISSN 0273-1177), vol. 6, no. 11, 1986, p. 57-60. refs

The emergence of the first life on the earth is now established as an early event, closely related to the evolving earth. Lack of knowledge of the primitive terrestrial conditions contemporary with the evolving prebiotic organic chemistry limits reconstruction techniques. The primitive earth's aqueous history is essential to unraveling this problem. Based on current knowledge of other planets of the solar system, no close analog to the early earth can be expected. It is still not known if there was a second origin or if only earth has life. This may depend upon the question of the survival of information-bearing chemical systems in a dynamic or chaotic environment and the chemical protection afforded within such a system. Water is the central molecule of controversy: the blessing and the curse of the chemist. New and novel chemical mechanisms and systems abound. Author

A87-49035* California Univ., San Diego, La Jolla.
CURRENT STATUS OF THE PREBIOTIC SYNTHESIS OF SMALL MOLECULES

STANLEY L. MILLER (California, University, La Jolla) IN: *Molecular evolution of life; Proceedings of the Conference, Lidingo, Sweden, Sept. 8-12, 1985*. Cambridge, England and New York, Cambridge University Press, 1986, p. 5-11. refs (Contract NAGW-20)

Experiments designed to simulate conditions on the primitive earth and to demonstrate how the organic compounds that made up the first living organisms were synthesized are described. Simulated atmospheres with CH₄, N₂, NH₃, and H₂O were found to be most effective for synthesis of small prebiotic molecules, although atmospheres with H₂, CO, N₂, and H₂O, and with H₂, CO₂, N₂, and H₂O also give good yields of organic compounds provided the H₂/CO and H₂/CO₂ ratios are above 1 and 2, respectively. The spark discharge (which is a good source of HCN) and UV light are also important. Reasonable prebiotic syntheses

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were worked out for the amino acids that occur in proteins (with the exception of lysine, arginine, and histidine), and for purines, pyrimidines, sugars, and nicotinic acid. Many of the molecules that have been produced in these simulated primitive-earth experiments are found in carbonaceous chondrites. I.S.

N87-27410*# National Aeronautics and Space Administration, Washington, D.C.

EXTRATERRESTRIAL CIVILIZATIONS: PROBLEMS OF THEIR EVOLUTION

L. V. LESKOV Aug. 1987 48 p Transl. into ENGLISH from Novoye v Zhizni, Nauke, Tekhnike, Seriya: Kosmonavtika, Astronomiya (USSR), no. 8, 1985 p 1-55 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.

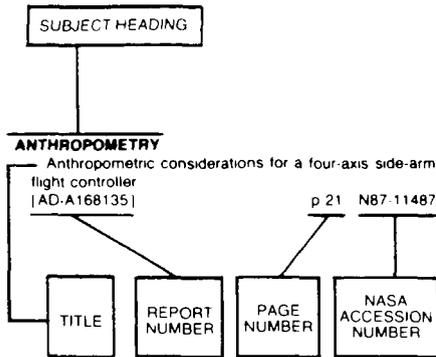
(Contract NASW-4006)

(NASA-TT-20060; NAS 1.77:20060) Avail: NTIS HC A03/MF A01 CSCL 06C

The problem of finding extraterrestrial civilizations and establishing contact with them is directly related to the problem of their evolution. Possible patterns in this evolution and the stages in the evolution of extraterrestrial civilizations are examined.

Author

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

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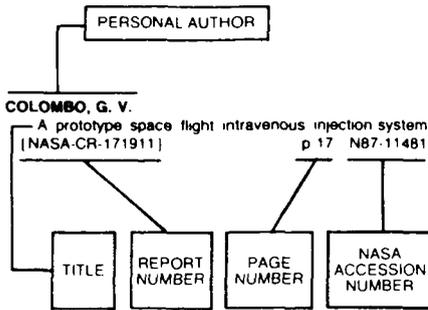
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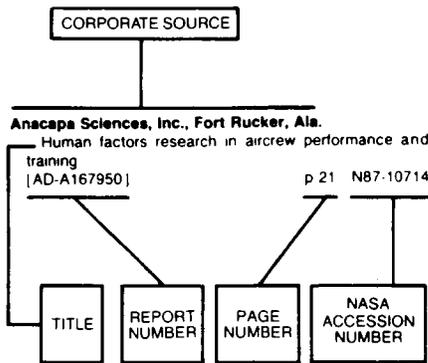
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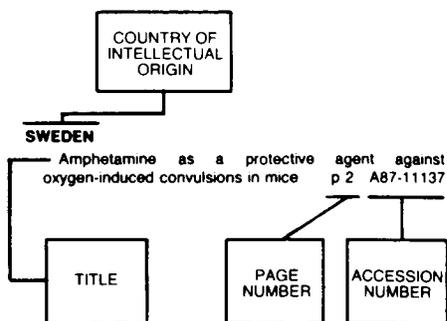
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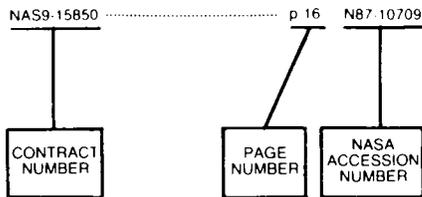
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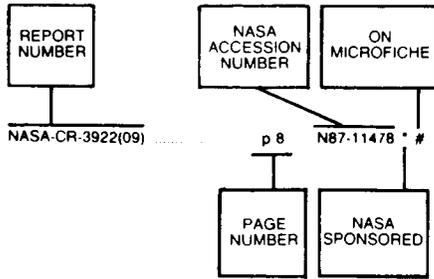


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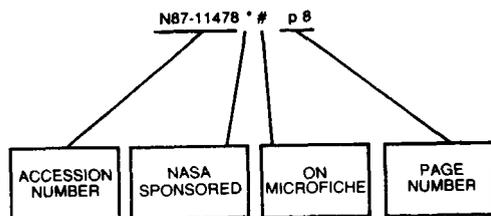


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